Three Essays in Economics of Catastrophes

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Introduction

The thesis comprises three empirical applications, each investigating different topics related to public economics, with a particular attention to the phenomena described as "catastrophic". Many events can be considered catastrophic for an economic setting, such as natural disasters, wars, migrations, pandemic diseases, etc. I focus on three of them: catastrophic agglomeration of firms, as a response to tax differentials; immigration phenomena, described as catastrophic by the natives; catastrophic earthquakes, resulting destructive for both physical and human capital.

The strong wording that describes these phenomena is not the only thing that they have in common. Despite being described as tragic events by the people suffering them, it is not straightforward to find evidence of their negative impact in the medium to long-run.

Catastrophic agglomeration appears dramatic to the jurisdiction that is abandoned by an important firm or set of firms, but – in the long-run – firms are simply trying to find the economic conditions that allow them to compete and perform better.

Immigration is often described as a tragedy by the anti-immigrant parties. However, immigrants are sometimes the sparkle that ignites the innovation and growth engine. Indeed, many countries, the US in primis, have grounded their development on immigration inflows.

Earthquakes are unpredictable and terrible natural disasters causing dramatic damages and – sometimes – asking for a high price in terms of human lives. It would seem immediate to infer that physical capital destruction and casualties cannot be an ideal mix to sustain economic growth. However, many scholars have found a positive long-term effect of such events.

In this thesis, I will analyze these phenomena with open eyes, without allowing the priors – that every individual inevitably has – to influence my critical judgement.

In the first chapter, "Catastrophic Agglomeration: Indirect Evidence from the Tax Sensitivity of Firm Births?" (with Mario Jametti e Marius Brülhart), I empirically test the existence of a phenomenon called "catastrophic agglomeration" by the New Economic Geography literature. In particular, I assess whether strong clustering-forces can be triggered by small changes in some underlying parameters, at

critical thresholds. Using counts of firm births in 132 industrial sectors in the 213 largest Swiss municipalities, I search for evidence for the implied discontinuities in the data, relating the clustering intensity of industries to those industries' sensitivity to differential tax burdens across locations.

The standard result in the tax competition literature on mobile factors, namely a race-to-the-bottom in profit tax rates and a shift of the tax burden to more immobile factors (Zodrow and Mieszkowski, 1986, and Wilson, 1986), has been refined on various fronts both theoretically and empirically in recent years.

One strand of research, the new economic geography (NEG) suggests, on the one hand, that agglomeration economies generate rents that can in principle be taxed by the local jurisdiction (Ludema and Wooton, 2000; Baldwin and Krugman, 2004; Borck and Pflüger, 2006), and, on the other hand, agglomeration rents might render firms less sensitive to tax differentials. Using Swiss municipal data, Brülhart, Jametti and Schmidheiny (BJS, 2012) show that (sectoral) agglomeration forces can indeed reduce the tax-sensitivity of new firms in their location decision. However, in their econometric specifications the change in the sensitivity to taxation for firm location is considered to be continuous and linear, as their coefficient of interest is an interaction term between the level of taxation and a measure of sectoral agglomeration.

Using progressively more flexible estimation strategies, I find that the tax sensitivity of firms' location choices falls off sharply around the 80th percentile of observed agglomeration intensity. This result is consistent with the jump discontinuity implied by the theory.

In the second chapter, "Stop invasion! Immigrants and the rise of populism in Europe" (with Massimo Bordignon and Gilberto Turati), I investigate the effects of the presence of immigrants in the North of Italy – specifically in Lombardy – which has often been described as "catastrophic" by the Northern League, a right-wing political party which has made anti-immigration stances the basis of its political platform. Populist parties with an anti-immigrant stance have flourished all around Europe, raising questions about the determinants of their success. A great attention has been devoted to the effect of immigration on the support for these parties all over Europe, but far less has been paid to the channels through which immigration is connected to this political success. I distinguish between the "ideological" anti-immigrant channel of the votes from two "rational" channels – crowding-out of social services and competition on the labor market – arising from differences in economic features of immigrants with respect to Italians. I investigate these channels using a particularly rich dataset on Lombardy and taking advantage of the fortuitous coincidence of national and regional elections.

A positive effect of immigration has been found in Denmark, Germany, Austria and Italy[1]. However, Steinmayr (2016) find a negative effect of refugees on the FPÖ vote share. Mendez and

[1] Dustmann et al. (2016), Harmon (2015), Gerdes and Wadensjo (2010) in Denmark; Otto and Steinhardt (2014) in Germany; Halla et al. (2016) in Austria; Barone et al. (2014) in Italy.

Cutillas (2014) detect no significant effect on support for anti-immigrants coalition in Spain, even though they find a positive effect for African immigrants. Becker and Fetzer argue that immigration in the UK has fostered the support for UKIP, while Levi et al. (2017) argue that it has only had a short-run positive effect on Brexit and UKIP's support, which vanishes over time.

Thanks to a unique - recently released - dataset, we contribute to the existing literature accounting for income (and tax) differentials between immigrants and Italians[2] at the municipal level. Lombardy constitutes a good socio-economic context for our analyses, having the highest share of immigrant population and being amongst the ones with the highest support for the Northern League.

In the third chapter, "Piling up catastrophes: The economic long term effect of earthquakes" (with Matteo Gamalerio), I empirically test the medium and long-term effect of catastrophic earthquakes, i.e. the highly destructive ones. In a cross-section framework, I analyze the long-term effect, using a particularly rich dataset – at the municipal level – on historic earthquakes in Italy. Moreover, I investigate the medium-term effect of earthquakes on economic and social development over the last 150 years, in a panel framework, thanks to a newly assembled dataset on historical socio-economic data about Italian regions.

The results suggest that in the long-run destructive earthquakes seem to have a positive effect on the per-capita municipal disposable income, number of firms per capita and number of non-profit organization (a measure often used as a proxy for social capital). In the medium run, only destructive earthquakes seem to have a positive effect on the evolution of regional gross domestic product (GDP) and value added per capita. In the medium term, catastrophic earthquakes (i.e. the one causing casualties) do not seem to affect the evolution of GDP and value added per capita. However, the effect on the human development index is not clear cut: destructive earthquakes keep on having a significant impact, but – at least in the medium term – catastrophic ones negatively affect the evolution of the HDI. As a corollary, we find that the INGV seismicity classification is not very useful to understand the effect of earthquakes on the economic development, since it does not account properly for the way in which earthquakes lay out their medium and long-term effect on the economic system.

[2] We carefully avoid the use of the word "natives" because here the discriminating factor is the citizenship, which also gives the right to vote. The number of non-natives who have gotten the Italian citizenship in Lombardy now exceeds two hundred and twenty thousand individuals, about 20% of the current number of immigrants.

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Catastrophic Agglomeration: Indirect Evidence from the Tax Sensitivity of Firm Births

with Marius Brülhart, *University of Lausanne*
Mario Jametti, *Università della Svizzera italiana*

1.1 Introduction

The standard result in the literature on tax competition with mobile factors, namely a race-to-the-bottom in profit tax rates and a shift of the tax burden to more immobile factors (Zodrow and Mieszkowski, 1986; Wilson, 1986), has been refined on various fronts, both theoretically and empirically, in recent years. One strand of research, the New Economic Geography (NEG), suggests, on the one hand, that agglomeration economies generate rents that can in principle be taxed by the local jurisdiction (Ludema and Wooton, 2000; Baldwin and Krugman, 2004; Borck and Pflüger, 2006), and, on the other hand, that agglomeration rents might render firms less sensitive to tax differentials.

The NEG most famous model, the "core-periphery" model, allows for full agglomeration of the mobile sector in a single region – the core – while only the immobile sector remains also in the other region – the periphery. In such a setting, a small change in the parameters defining the equilibrium might trigger a sudden move of all the firms belonging to the mobile sector towards a single location. This phenomenon has been defined "catastrophic agglomeration" by Krugman (1991) and later on Baldwin et al. (2001) described such "catastrophes" as "perhaps the most celebrated feature of the core-periphery model".

Prior empirical research based on time-series evidence has not been kind to the discontinuities implied by the theory, finding economic geography to be highly persistent even in the face of large exogenous shocks (Davis and Weinstein, 2002; Davis and Weinstein, 2008; Brakman, Garretsen and Schramm, 2004). This has led researchers to consider "catastrophes" as mainly a theoretical curiosity[1].

Using Swiss municipal data, Brülhart, Jametti and Schmidheiny (BJS, 2012) show that (sectoral) agglomeration forces can indeed reduce the tax-sensitivity of new firms in their location decision. However, in their econometric specifications the change in the sensitivity to taxation for firm location is considered to be continuous and linear, as their coefficient of interest is an interaction term between the level of taxation and a measure of sectoral agglomeration. This result emerges by construction, because their specification allows neither for non-linearities nor for catastrophes.

In this chapter, we extend the BJS result in a number of ways, using the same dataset including the 213 largest Swiss municipalities – spread over 132 industrial sectors. The first avenue is to explore whether the tax sensitivity of firm location changes non-linearly with the degree of sectoral agglomeration. We relax the linearity assumption by estimating, with Poisson, some polynomial and spline specifications. The polynomial specifications allow us to assess whether there are strong non-linearities linked to sectorial agglomeration. The spline specification - even though it forces the relationship to be continuous - lets the parameters vary over the range of the agglomeration index. Our estimates suggest that there might be structural changes in the right tail of the distribution of the agglomeration index: the effect of taxes on new firm births, indeed, gets reversed.

[1] According to Head and Mayer (2004, p. 2662), "(c)atastrophes (...) should perhaps be considered more as fascinating theoretical 'exotica' rather than as robust elements of economic geography". Similarly, Combes et al. (2008, p. 337) concluded that the "studies undertaken to date seem to converge in invalidating the existence of phenomena such as catastrophes".

Further, we allow the tax effect to vary discontinuously with sectoral agglomeration, estimating percentile regressions. In order to take seriously the possibility of catastrophic outcomes, we consider two parametric, piecewise linear or polynomial specifications, allowing for jumps in the effect of taxes. Specifically, we estimate regressions over quintiles and deciles of the agglomeration index, in order to verify whether there could be any level of it for which there could be a significant jump in the overall effect of taxes. This estimation strategy confirms that, if there is any discontinuity, it should take place for high values of the agglomeration index. Nonetheless, we are aware that dividing the agglomeration index into quintiles or deciles is somehow arbitrary. Hence, we investigate whether we find a structural break in the effect of taxes.

We perform a Quandt test over different percentiles of the observed agglomeration index, in order to detect evidence of a potential structural break in the effect of local taxes' differentials. To operationalize this procedure we consider a regression over two sections of both the direct effect and the interaction term between the corporate tax rate and the agglomeration index. The two sections have a variable length, depending on the value of the chosen threshold: we repeat the estimates for each possible threshold between the 16th and the 85th percentile of the agglomeration index.

Our results suggest that the deterrent effect of higher local taxes is fairly stable for the lower four fifths of industries by agglomeration intensity, but that this effect is reduced abruptly around the 80th percentile. The highly agglomerated sectors are essentially insensitive to tax differentials. The remainder of the paper is structured as follows. Section 1.2 presents a brief literature overview and motivation for the paper. Section 1.3 introduces a theoretical model and section 1.4 describes the data and the empirical methodology. Section 1.5 presents the main results and section 1.6 discusses them. Section 1.7 concludes. All figures and tables are at the end of the chapter.

1.2 Literature review

The presence of agglomeration economies modifies the standard tax competition setting among jurisdictions. When local governments compete to attract (or to keep) the mobile tax base the existence of agglomeration economies can – in principle – either be a relaxing or tightening factor. If they act as a loosening factor the result is a "lumpy" world:

agglomeration forces push firms to concentrate in specific jurisdictions, provided that restrictions to trade (such as trade costs) are sufficiently low. This phenomenon generate rents for firms operating in an agglomerated sector and these rents can be taxed, because firms become less sensitive to tax differentials. The most relevant theoretical contributions include: Kind et al. (2000), Ludema and Wooton (2000), Andersson and Forslid (2003), Baldwin and Krugman (2004), Borck and Pflüger (2006), Commendatore et el. (2007), Baldwin and Okubo (2009), Feddersen (2010) and Commendatore and Kubin (2013).

On the other hand, agglomeration economies could exacerbate tax competition, because one firm's decision to relocate might actually cause other firms to mimic it, creating the conditions for the formation of a new cluster. In this case, as pointed out by Baldwin et al., (2001), and Konrad and Kovenock, (2009), agglomeration economies end up increasing the sensitivity of firms to tax differentials. The general prediction of New Economic Geography is that the probability that the mobile sector clusters within one region is decreasing in the cost of trade and that the greater the agglomeration forces, the lower the firms' sensitivity to tax differentials[2].

Empirical works by Charlot and Paty (2007), Jofre-Monseny and Solé-Ollé (2010 and 2012), Koh and Riedel (2010), Jofre-Monseny (2011), Lüthy and Schmidheiny (2013) and Fréret and Maguin (2017) find that jurisdictions hosting more concentrated sectors actually tax more than counterparts hosting firms operating in more dispersed sectors. Moreover Fréret and Maguin (2017) point out that even when neighboring jurisdictions lower their tax rates, *départments* with agglomerated sectors react less, by reducing their tax rates less than the ones with firms operating in low-agglomeration sectors.

In their study on plant location in the United Kingdom (UK) Devereux et al. (2007) analyze how agglomeration economies affect firms' sensitivity to local fiscal incentives when they choose where to locate. Their results suggest that regions with a bigger pre-existing stock of plants can attract more easily new plants thanks to their fiscal incentives. It is important to highlight that in the UK fiscal incentives are individually negotiated for each new plant. Something similar happens in Germany, where Bischoff and Krabel (2017) find that municipalities hosting big plants[3] tend to set lower corporate tax rates.

The standard "core-periphery" models do not account for the presence of taxes and allow only two possible location outcomes: a completely dispersed one and a completely

[2] Cfr. BJS footnote 4, for additional details.
[3] The authors call them "locally dominant firms", i.e. "firms contributing to a sizeable share to municipalities' revenues".

agglomerated one (Baldwin et al., 2001). Borck and Pflüger (2006) allow for partial agglomeration (even if in a setting without taxes), but point out that firm counts are less sensitive to tax differentials if they operate in agglomerated sectors. As a result, peripheral locations might be more effective in attracting new firms through fiscal inducements. As found by Rosenthal and Strange (2004) agglomeration economies decay quickly over space and hence they give a greater advantage to central urban municipalities.

The Swiss context is particularly convenient to study these phenomena, because the cantonal statutory corporate tax rates are neither firm nor sector specific, so there are not the issues that can be encountered in the UK or in Germany[4]. In BJS (2012) the authors take advantage of this setting introducing an interaction term between taxes and a sector-specific measure of agglomeration. They find that the sensitivity of new firms' birth to tax differentials is decreasing in the level of agglomeration of the sector in which they operate.

In this chapter, we further develop the BJS (2012) paper by using more flexible estimation technique to study the relationship between new firms' birth and the sector-specific agglomeration index. The functional form imposed in their estimates actually forced the results to show a smooth decay of sensitivity to tax differentials, implicitly ruling out the possibility of "catastrophic agglomerations", possibly the most interesting theoretical feature introduced by the core-periphery model. Allowing for different types of functional forms and in particular for structural breaks, we leave the data tell us whether this fascinating theoretical prediction is purely fictional or it is grounded in reality.

1.3 Theoretical model

The location decisions of new firms can be modelled in two different ways. On the one hand there is the footloose-startup approach, according to which investors choose where to set up a firm from a set of given locations. On the other hand there is the latent-startup model which states that there are a certain number of immobile potential entrepreneurs that decide continuously whether to start up a firm or not. While these two approaches are indistinguishable from an empirical analysis point of view, they are not identical from a theoretical model perspective. For the sake of simplicity we follow a standard footloose

[4] In the UK (and, similarly, in Germany) new firms can negotiate the tax rate with local governments.

entrepreneur approach, where entrepreneurs are mobile and decide where to set up their firm depending on the expected real return to their investment, i.e. the real relative profits.

We start from a basic model of New Economic Geography. There are 2 regions (North and South), 2 sectors (A, agriculture and M, manufacturing) and 2 production factors (H, entrepreneurs – who are mobile – and L, workers that are immobile). The model is symmetric in tastes, technology, trade costs and endowments. The utility function of a typical consumer is:

$$\mathrm{U} \equiv \mathrm{C_M^{\mu}} \cdot \mathrm{C_A^{1-\mu}} \tag{1}$$

where $\mathrm{C_M}$ is the consumption of the constant elasticity of substitution (CES) composite of industrial varieties, defined by:

$$C_M \equiv \left(\int_{i=0}^{n+n^*} c_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{2}$$

with $0 < \mu < 1 < \sigma$. μ represents the expenditure share of the industrial varieties; n is the mass (number) of north varieties and n^* is the mass (number) of south varieties; σ is the CES between varieties. We also define $\omega \equiv \frac{w}{p}$ the indirect utility function for typical northern entrepreneurs (which also corresponds to a typical firm's real profits) and $\omega_L \equiv \frac{w_L}{p}$ the one for northern workers, where w and w_L represent, respectively, the wage for entrepreneurs (the mobile factor H) and workers. The price index P is defined as:

$$P \equiv p_a^{1-\mu} (\Delta n^w)^{-a} \tag{3}$$

where,

$$\Delta \equiv \frac{\int_{i=0}^{n^w} p_i^{1-\sigma} di}{\mathrm{n^w}} \quad \text{and} \quad \mathrm{a} \equiv \frac{\mu}{\sigma-1}$$

The manufacturing sector (industry) is monopolistically competitive and shows increasing returns to scale. The production of a typical variety of the manufactured good requires 1 entrepreneurs (implying a fixed cost of Fw, where $F = 1$) and a_m units of worker's labor for each unit of output produced. Hence, the total cost of producing x units of a variety can be written as:

$$w + w_L a_m x \tag{4}$$

with the first addendum representing the fixed costs and the second the variable ones. The trade in industrial goods suffers from iceberg trade costs, hence, to sell 1 unit in the other country it is necessary to ship $\tau > 1$ units, because $\tau - 1$ unit melts in the transportation process.

The agricultural good, instead, is homogeneous, subject to perfect competition, has a constant return to scale production process, which requires workers only. The cost of production of the agricultural good is $w_L a_A$. Each region is endowed with the same number of workers, which are interregionally immobile, hence $L = L^* = L^w/2$ where L^w is the world supply of workers. Entrepreneurs are interregionally mobile and their spatial allocation across regions is then endogenous. Entrepreneur's migration decisions are based on real wage differences; we can write the migration equation as follows:

$$s_H^{\cdot} = (\omega - \omega^*)\frac{H}{H^w}\left(\frac{H^w - H}{H^w}\right) \tag{5}$$

where H^w is the world supply of entrepreneurs. The migration equation depends on the real wage gap and the share of entrepreneurs in the North and in the South respectively.

In the short run equilibrium, in the agricultural sector, marginal cost pricing is applied:

$$p_A = a_A w_L \qquad p_A^* = a_A w_L^* \tag{6}$$

and the non-full-specialization (NFS) condition implies that the world expenditure on good A has to satisfy the condition:

$$(1-\mu)E^w > \frac{1}{2}\frac{L^w}{a_A} \tag{7}$$

The worldwide demand for good A can be written as:

$$C_A = (1-\mu)\frac{(E + E^*)}{p_A} \tag{8}$$

where E and E^* are the consumption expenditure in the north and the south respectively. Conversely, a constant share μ of expenditure is spent on industrial goods. The northern consumption of variety j can be expressed as:

$$c_j = p_j^{-\sigma}\ \left(\frac{\mu E}{\Delta n^w}\right) \quad \text{with} \quad E = wH + w_L L \tag{9}$$

Given monopolistic competition and the structure of the demand functions, mill-pricing is optimal:

$$p = \frac{w_L a_M}{1-1/\sigma} \qquad p^* = \frac{\tau w_L a_M}{1-1/\sigma} \tag{10}$$

and the pricing equations depend on the wages of the immobile factor, which is the same in both regions, because the trade of good A is costless.

The reward of an entrepreneur is the profit $(\Pi = \omega \equiv w/p)$ of a typical variety. Mill-pricing and constant mark-up imply that profits are equal to the value of sales multiplied by the profit margin $(1/\sigma)$. Hence, the profits for a northern and a southern entrepreneur are, respectively:

$$w = \Pi = \frac{\mu}{\sigma} \cdot B \cdot \frac{E^W}{n^W} \quad \text{and} \quad w^* = \Pi^* = \frac{\mu}{\sigma} \cdot B^* \cdot \frac{E^W}{n^W} \tag{11}$$

where

$$B \equiv \left(\frac{s_E}{\Delta}\right) + \varphi\left(\frac{1-s_E}{\Delta^*}\right) \quad \text{and} \quad B^* \equiv \left(\frac{\varphi s_E}{\Delta}\right) + \left(\frac{1-s_E}{\Delta^*}\right) \tag{12}$$

with

$$\Delta \equiv s_n + \varphi(1 - s_n) \quad \text{and} \quad \Delta^* \equiv \varphi s_n + (1 - s_n) \tag{13}$$

and, finally, $s_E = E/E^W$ and $s_n = n/n^W$.

The spatial allocation of expenditure depends on the spatial distribution of industry and on the parameters of the model. We can express the world expenditure as:

$$E^w = w_L L^w + \frac{\mu}{\sigma} E^w \tag{14}$$

which – defining $b \equiv \mu/\sigma$ – can be rewritten as

$$E^w = \frac{w_L L^w}{1 - b} \tag{15}$$

The full employment of entrepreneurs implies that $n^w = H^w$, hence the share of expenditure can be expressed as:

$$s_E = (1 - b)s_L + bBs_H \tag{16}$$

where s_L is the northern share of workers and s_H is the northern share of entrepreneurs. Given that we are in the symmetric case, $s_L = 1/2$, hence, the relative market size depends on the location decision of the mobile factor s_H and on its profitability B. This also implies that production shifting (changes in s_H) will lead to expenditure shifting (changes in s_E).

Finally, the typical industrial firm's cost function is non-homothetic, hence the equilibrium firm size (x) depends on relative factor prices:

$$x = \frac{\Pi\sigma}{p} \tag{17}$$

We now normalize the variables of the model in order to simplify and make it more tractable. We choose sector A as numeraire and take units such that $a_A = 1$ so that $w_L = w_L^* = 1$. We set $a_m = 1 - (1/\sigma)$ so that the northern and the southern price of a typical northern variety are $p = 1$ and $p^* = \tau$. As a result, our normalizations boil down to:

$$p_A = p_A^* = w_L = w_L^* = 1, \quad \varphi = \tau^{1-\sigma}, \quad n^w \equiv n + n^* = 1, \quad H^w \equiv H + H^* = 1,$$

$$n = H = s_n = s_H, \qquad n^* = H^* = s_n^* = 1 - s_n, \qquad L^w = 1 - b, \quad E^w = 1$$

The long-run equilibrium has the same properties of the short-run one, but all migration stops. This can happen at an interior solution – i.e. for $0 < s_n < 1$ – when migration stops because entrepreneurs achieve the same level of utility in both regions $(\omega = \omega^*)$ or at a core-periphery (CP henceforth) outcome – i.e. for $s_n = 0$ or $s_n = 1$.

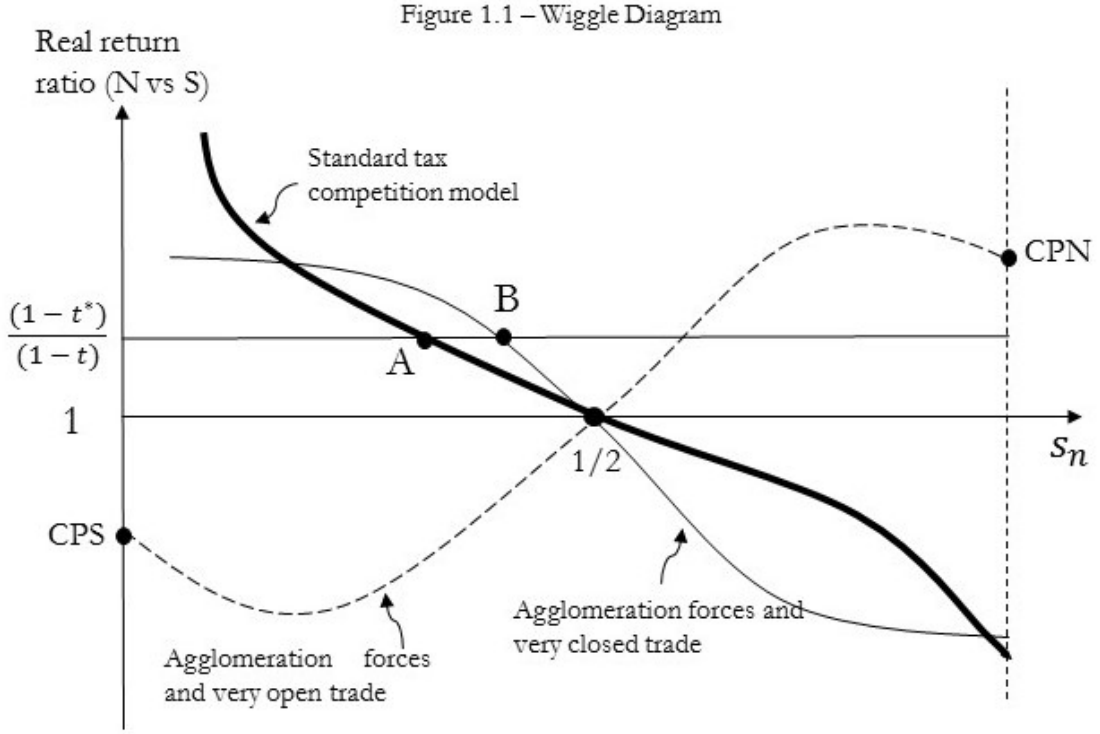
When trade freeness rises beyond the break point (φ^B), the interior solution becomes unstable, while the CP outcomes become stable and a slight shock to an interior solution generates self-reinforcing forces, resulting in catastrophic agglomeration. Agglomeration rents are a concave function of trade freeness: as trade gets freer – i.e. φ rises from φ^S towards 1 – agglomeration forces first rise and then fall.

The standard tax competition literature relies on smooth models in which small changes lead to small effects. The economic geography models, on the contrary, are "lumpy" by their very nature, because of agglomeration forces, as shown by Kind et al (2000), and Ludema and Wooton (2000). Spatial concentration of economic activities creates forces that favor further concentration. This can be illustrated with a standard "wiggle diagram" (Figure 1.1).

The vertical axis shows the real return ratio (of the North over the South) of the mobile factor. The horizontal axis shows the North's share of the mobile factor, denoted as s_n which is a measure of agglomeration. When the reward is higher in the North, the entrepreneurs will move to the North, and vice-versa if it is higher in the South. In a standard neoclassical model the situation would be the one described by the thick solid line: the real reward of locating in the north is always downward sloping and it is unity for $s_n = 1/2$. If we start at this point, raising the taxes in the north, generating a tax gap, would push some firms to the south, until we get to point A, where the real reward between the two regions are equalized again. The same behavior can be observed when

agglomeration forces are present, but trade is quite restricted. The situation is depicted by the thin solid line: in this case the same tax gap would generate smaller migration towards the south.

Figure 1.1 – Wiggle Diagram



However, when trade gets free enough, the relationship between the reward ratio and the dispersion of firms is reversed. The dashed line shows that the slope is positive at $s_n = 1/2$, which means that at this level of openness, agglomeration forces are so strong that the benefit of agglomerating in one region tends to increase as the extent of the agglomeration increases. Moreover, the real reward is higher in the north when all firms locate in the North (CPN) and is higher in the south when all firms locate to the South (CPS). Hence, asymmetric taxation can have no effect on location: if the real reward is above the tax gap, the firm is still better off staying in the high tax region.

Translating this into our setting, we can interpret the sensitivity of new firm births to tax gaps as tax-base responsiveness to taxation at different level of sectoral agglomeration. Firms locate where the real return ratio is higher after having taken into account taxes.

Analytically, our previous normalizations imply that:

$$\Delta = 1, \quad \Delta^* = \tau^{1-\sigma} \quad \Rightarrow \quad P \equiv 1, \quad P^* \equiv \varphi^{-a}$$

We can now rewrite the profit functions for the North and the South as:

$$\Pi = b\left[\frac{s_E}{\varphi + n(1-\varphi)} + \frac{\varphi(1-s_E)}{1-n(1-\varphi)}\right] \tag{18}$$

$$\Pi^* = b\left[\frac{\varphi s_E}{\varphi + n(1-\varphi)} + \frac{1-s_E}{1-n(1-\varphi)}\right] \tag{19}$$

Using these two profit equations and the North and South price levels, we can write the equation for Ω, which defines the ratio of the real returns for an entrepreneur, net of taxes:

$$\Omega = \frac{\frac{\Pi}{P}}{\frac{\Pi^*}{P^*}} = \frac{(1-bZ)\varphi^{-a}}{1+bZ-4bnZ} \tag{20}$$

where

$$Z = \frac{1-\varphi}{1+\varphi} \tag{21}$$

If we now account for taxes, where t is the tax rate in the North and t^* the tax rate in the South, the relative taxation is defined by $T = (1-t)/(1-t^*)$. The equilibrium condition for the entrepreneur then becomes $T \cdot \Omega = 1$, i.e. the return for the entrepreneur is the same once accounting for relative taxes. Rearranging the equilibrium condition, we get that $\mathrm{T} = 1/\Omega$, from which – taking the derivative with respect to n and rearranging once again – we obtain:

$$\frac{dn}{dT} = -\frac{\Omega^2}{\frac{d\Omega}{dn}} = \frac{(1-bZ)\varphi^{-a}}{4bZ} \tag{22}$$

From the previous equation it is possible to derive a threshold value for Z, which we call Z^c, because it defines the boundary region within which a small tax change might lead to a catastrophic location effect. Given that Z is a measure of closedness, when $Z > Z^c$ trade is closed enough and we do not get the CP outcome. When trade becomes freer, i.e. $Z < Z^c$, a small change in T can trigger a CP outcome. The critical value Z^c can be written as:

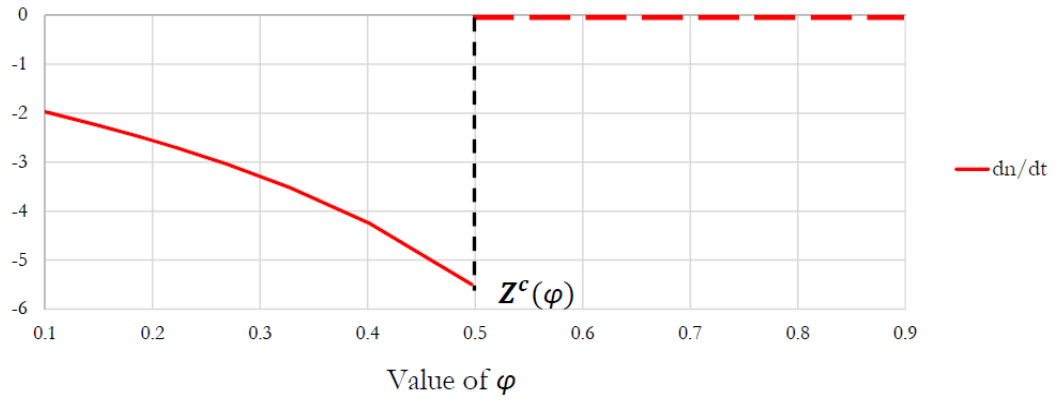
$$Z^c = \frac{\psi - \sqrt{\psi^2 - 4(a+b)^2}}{2(a+b)}, \qquad \psi \equiv 1 + b(b+2a) > 0 \tag{23}$$

Both dn/dT and Z^c are functions of Z, b, a and φ, a fact that allows us to rewrite their expression as a function of the three basic parameters μ, σ and τ. Finally, it is important to highlight that in our empirical analysis we will compute the effect of agglomeration economies on the sensitivity of new firms birth with respect to the tax rate of a municipality, that is with respect to t and not to T. However, using the chain rule, we can rewrite dn/dT as:

$$\frac{dn}{dT} = \frac{\partial n}{\partial T} \cdot \frac{\partial T}{\partial t} = -\frac{1}{1-t^*} \cdot \frac{\partial n}{\partial T} \tag{24}$$

Calibrating the parameters μ, σ and τ for real world consistent values and choosing t^* equal to the average corporate income tax rate on a median firm[5], we can plot dn/dt and get the graph shown in Figure 1.2. The sensitivity to φ-ness, i.e. openness (φ is inversely related to Z^c) indicates the critical level $Z^c(\varphi)$, below which we have a CP outcome and new firms birth become insensitive to changes in t, i.e. $dn/dT = 0$.

Figure 1.2 - Sensitivity of the tax base to changes in the tax rate depending on openness of the economy



In section 1.5 we will show the empirical counterpart of Figure 1.2 and in section 1.6 we will compare them.

[5] Specifically, we set $\mu = 0.86$, which was the share of expenditure on non-agricultural goods of the Swiss families in the period 1998-2001 (source: UST, National accounts); moreover, σ has been set equal to 4 and $\tau \in [1.05, 1.95] \Rightarrow \varphi \in [0.14, 0.86]$; finally, $t^* = 10.72\%$ which is the average corporate income tax on a median firm.

1.4 Data and empirical setting

1.4.1 Data

We use the same dataset as BJS[6]. It covers the 213 largest Swiss municipalities and 132 industrial sectors[7] for a total of 28,116 observations. Basic descriptive statistics are summarized in Table 1.1.

Our dependent variable consists of the count of new firms' birth in each municipality and sector, pooled over the period 1999-2002. New firms are all market-oriented business entities that have been founded in the year concerned and are operating for at least 20 hours per week. Data stems from the project "Unternehmensdemografie" (UDEMO) of the Swiss Federal Statistical Office, which also provides information about the firm's main sector of activity by three-digit sector of the European NACE classification.

Our three main regressors are: the (municipal) corporate tax rate, an index of sector agglomeration and the stock of existing firms in each municipality. The reference year for all control variables is 1998[8].

The municipal corporate tax rate is defined as the municipal-plus-cantonal average corporate income tax rate for a firm with median profitability. Cantonal tax laws define the basic corporate income tax schedule, which, among others, determines the degree of progressivity. In most cases, municipalities annually select a tax multiplier, i.e. a shifter to the basic tax schedule. There is an important corporate tax rate variation across and within Swiss Cantons. Overall, in our sample, the corporate tax rate for a firm with median return on capital varies between 5% and 16% (Table 1.1). Finally, it is important to note that the Swiss fiscal system does, in general, not allow for firm or sector-specific tax regimes[9].

As the sectoral agglomeration index we chose the Ellison-Glaeser (EG) index for spatial concentration (Ellison and Glaeser, 1997), which controls for differences in firms numbers across sectors in quantifying the extent of geographical clustering, above industrial structure.

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[6] See BJS for more details on the dataset.

[7] The sectors for which no firm births are observed were dropped from the dataset. Moreover, we retained only Activities pertaining to the private sector. This left us with 132 three-digit sectors.

[8] See Table 1.1 for additional details.

[9] One exception to this rule is that cantons may offer tax deals with new firms for up to 10 years. Data on these deals are unavailable. Using the count of new firms alleviates tax-rate measurement errors, as the number of such deals is likely small compared to total firm births.

Table 1.1 - Descriptive statistics

VARIABLES	Varies by	Mean	Standard deviation	Min.	Municipality / sector with min.	Max.	Municipality / sector with max.
New firms†	mun., sector	0.922	7.859	0	*several*	694	Zurich, legal and management consultancy services
Tax (avg. Corporate income tax rate on median firm)‡	mun.	10.720	2.124	5.342	Freienbach	15.843	Giubiasco
EG index	sector	0.013	0.021	-0.043	production of paints & printing inks	0.169	Accessory services for transport
EGS index [EG index - mean(EG index)]	sector	1.87E-10	0.693	-0.056	production of paints & printing inks	0.156	Accessory services for transport
PEG index (ordinal EG index)	sector	0.503	0.288	0.008	production of paints & printing inks	1	Accessory services for transport
Stock of firms	mun., sector	5.859	36.257	0	*several*	2372	Zurich, other retail business
Wage*	mun., sector	5.600	0.773	3.378	*several*	7.773	*several*
Property price$^{\kappa}$	mun.	1.803	0.290	1.114	Le Locle	2.679	Zollikon
Income tax rate‡	mun.	6.632	1.389	2.733	*several*	9.375	*several*
Public expenditure$^{\mu}$	mun.	14.278	2.558	10.181	Wettingen	21.022	Basel, Riehen
Market potential$^{\bullet}$	mun.	1.140	0.629	0.277	Bex	4.394	Ecublens
Distance to highway††	mun.	4.349	6.530	0.028	Morges	59.919	St. Moritz
Assisted municipality	mun.	0.249	0.432	0	*several*	1	*several*
Population$^{\iota}$	mun.	17.361	31.365	4.055	Sainte Croix	351.838	Zurich

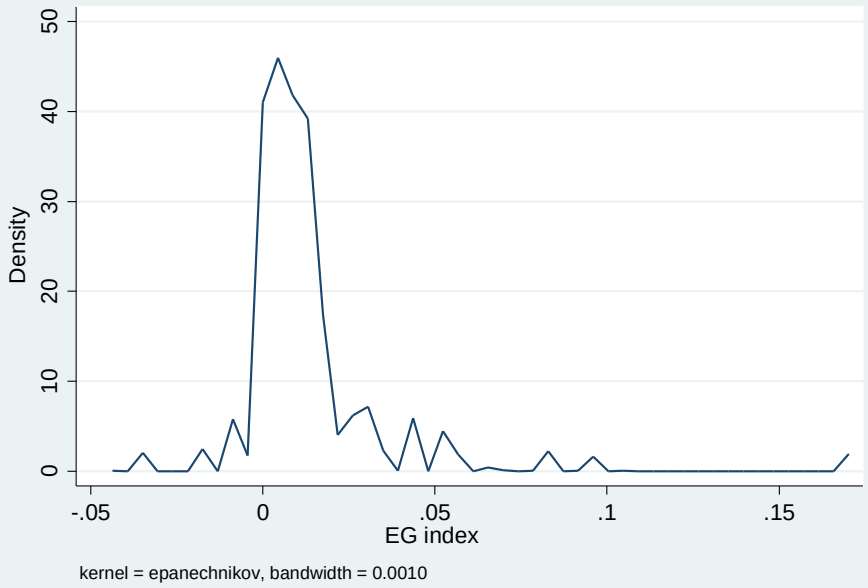
Notes. NACE three-digit sector level; data for 1998 unless stated otherwise; 28,116 observations. †Over period 1999-2002, ‡in %, *in 2000 in thousand Swiss francs, $^{\kappa}$in 2002, $^{\mu}$per capita in thousand CHF, $^{\bullet}$based on 1992 municipal incomes in million CHF, ††in kilometers, $^{\iota}$in thousand.

Lastly, the stock of pre-existing firms consists of the number of active firms in each sector and municipality. The data source for the stock of firms and the calculated EG-index is the multi-annual firm census in Switzerland[10].

We also account for other municipal controls in the specifications where we do not include municipality fixed effects, to control for other socio-economic aspects that might affect firms' location decisions. These vary either by municipality or by both municipality and sector. The controls varying by municipality are: property price, (personal) income tax rate, public expenditure, market potential, distance to highway, a dummy for assisted municipalities and municipal population. Further, we control for wages, which vary by aggregate sectors and regions.

Figure 1.3 shows the distribution of the Ellison-Glaeser index in our sample. It can easily be seen that the distribution is quite skewed to the right. We applied two standardizations: we de-meaned it (EGS index) and we computed the cumulative version of it (PEG index).

Figure 1.3 - Kernel density estimate of the Ellison & Glaeser index



The EGS index allows us to replicate the estimates of the BJS paper which interprets the estimated coefficient on the tax variable as the effect of taxes for a sector with average spatial concentration. The ordinal cumulative (PEG) index gives the same weight to a

[10] Project "Betriebszählung" (BZ) by the Swiss Federal Statistical Office.

change from one value of the agglomeration index to the following one, to take account of the skewness in the original EG index. The resulting distribution of the cumulative index is indeed uniform.

1.4.2 Empirical setting

The starting point of our exercise is the regression specification in the BJS paper using sectoral fixed effects

$$y_{is} = \alpha_s + \beta_0 T_i + \beta_1 (T_i \cdot AI_s) + \gamma S_{is} + \delta X_i + \eta Z_{is} + \varepsilon_{is} \qquad (25)$$

where y_{is} is the count of new firms' birth, which depends on the tax rate (T_i), the agglomeration index (AI_s) and the stock of existing firms (S_{is}). The distinctive feature of the BJS paper is the interaction term between the agglomeration index at the sector level and the municipal tax rate. Finally, the regression controls for sector fixed effects (α_s) municipal controls (X_i) and a set of interactions between municipal controls and the agglomeration index. Note that the main effect of AI_s is absorbed by the fixed effects[11]. The marginal effect of taxes, in the OLS case, for (25) is:

$$\frac{\partial y_{is}}{\partial T_i} = \beta^0 + \beta_1 AI_s \qquad (26)$$

We did not focus on municipal fixed effects for a technical reason: they would have washed the direct tax effect out, because taxes are municipality specific, hence they would have become part of the fixed effects. Interpreting the overall effect of taxes without the direct effect would be tricky. Instead, we decided to include in our main analyses a set of municipal controls, which - we reckon - enables us to take into account socio-economic specificities of each municipality. The estimates including municipal fixed effects are not significantly different from the ones using our set of municipal controls (as it will be discussed in section 1.5.3); hence, for the most advanced specification (i.e. the estimates over two setions and the Quandt test) we will not use the municipal fixed effects, but only sector fixed effects and the set of municipal controls.

[11] Alternatively, BJS estimate the above equation also including municipal fixed effects (α_i). This implies that here the main effect of taxes is absorbed by the municipal fixed effects.

Dealing with count data, the appropriate way to estimate the effect of taxes on new firms' birth is through a Poisson regression model. The model that we are going to estimate can be synthetically expressed by the following equation:

$$y_{is} = exp[F(W)] \tag{27}$$

where $F(W)$ describes the particular model specification we are considering. Similar to BJS, we use Poisson fixed effects estimators for all our specifications and present marginal effects for the coefficients of interest.

We propose four alternative empirical strategies to allow for potential non-linearities or discontinuities in the above setting: (i) polynomial estimation; (ii) splines; (iii) estimation over percentiles; (iv) estimation over two sections of variable length, allowing the main effect and/or the interaction term to differ over the two sections of the agglomeration index distribution. As a complement to strategy (iv) we perform a Quandt test for structural break in order to figure out whether and where - along the AI distribution - there might be a structural break in the effect of taxes.

Following the NEG literature we allow for potential non-linarities only along the agglomeration index, assuming that non-linear effects in the firms' location choices can be driven only by the concentration of the sector.

To fit strategy (i), we performed polynomial estimates[12] of the interaction between the tax rate and the agglomeration index raised at the second ($p = 2$), third ($p = 3$) and fourth ($p = 4$) power; hence, we have that:

$$F(W) = \alpha_s + \beta_0 T_i + \sum_{\tau=1}^{p} \{\beta_\tau [T_i (AI_s)^\tau]\} + \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \tag{28}$$

The estimated overall effect of taxes is:

$$\frac{\partial y_{is}}{\partial T_i} = \left\{\beta_0 + \sum_{\tau=1}^{p} \{\beta_\tau (AI_s)^\tau\}\right\} exp[F(W)] \tag{29}$$

To pursue strategy (ii) we estimated a spline over quintiles ($p = 5$) and deciles ($p = 10$) of the agglomeration indexes, fitting a Poisson regression where:

[12] The polynomial terms have been orthogonalized in all specifications.

$$F(W) \;=\; \alpha_s + \beta_0 T_i \;+ \beta_1 \left[\left(\sum_{q=1}^{p} d_q \right) AI_s \cdot T_i \right] +$$

$$+ \sum_{\{\tau=2\}}^{p} \left\{ \beta_\tau \left[\left(\sum_{q=\tau}^{p} d_q \right) (AI_s - c_{\tau-1}) T_i \right] \right\} + \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \quad (30)$$

where d_q are dummies for the respective percentiles of the agglomeration index, the β_τ coefficients refer to the interaction terms between the tax rate and each single percentile of the agglomeration index and c_τ is the cut-off value of the agglomeration index between one percentile and another. It should be noted that β_1 is the coefficient for the basic interaction term across percentiles, while the β_τ coefficients are incremental coefficients on top of β_1.

The estimated overall effect of taxes is:

$$\frac{\partial y_{is}}{\partial T_i} \;=\; (\beta_0 + \beta_1 \left[\left(\textstyle\sum_{q=1}^{p} d_q \right) AI_s \right] +$$

$$+ \sum_{\tau=2}^{p} \left\{ \beta_\tau \left[\left(\sum_{q=\tau}^{p} d_q \right) (AI_s - c_{\tau-1}) \right] \right\}) \exp[F(W)] \quad (31)$$

To implement strategy (iii) we fitted a Poisson regression over quintiles $(p = 5)$ and deciles $(p = 10)$ with:

$$F(W) \;=\; \alpha_s + \beta_0 T_i + \sum_{\rho=1}^{q} \sum_{\tau=1}^{p} \left[\beta_{\tau\rho} \left(T_i \cdot AI_s^{\rho} \cdot d\tau \right) \right] +$$

$$+ \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \quad (32)$$

were the $\beta_{\tau\rho}$ coefficients refer to the interaction terms between the tax rate and each single percentile of the agglomeration index; $d\tau$ is a set of dummy variables – one for each percentile.

The estimated overall effect of taxes is:

$$\frac{\partial y_{is}}{\partial T_i} = \left\{ \beta_0 + \sum_{\rho=1}^{q} \sum_{\tau=1}^{p} \left[\beta_{\tau\rho} \left(AI_s^{\rho} \cdot d\tau \right) \right] \right\} exp[F(W)] \quad (33)$$

Finally, to operationalize the Quandt test (Quandt, 1960), strategy (iv), we choose two sections of variable length with piecewise linear interactions. Strategy (iv) is borrowed from time series analysis, where it is most frequently used. It involves a repeated Chow test for structural breaks over each possible value of the threshold. The Chow test compares the goodness of fit of the estimates done with the full model to the restricted model. The Quandt statistic is the maximum value among these repeated Chow tests. Critical values for this test have been computed by Andrews (1993 and 2003) and are larger than the ones for a standard Chow test, since - being a repeated test - it has more chances to reject the null hypothesis of no structural break on the coefficient values. More specifically, we looked for break points over the central 70% of the values of the agglomeration indexes, leading to 70 possible break points, ranging from 16% to 85%.

In our analyses, the restricted model is defined by a Poisson regression with

$$F(W) = \alpha_s + \beta_0 T_i + \beta_1 (T_i \cdot AI_s) + \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \qquad (34)$$

where the marginal effect of taxes is:

$$\frac{\partial y_{is}}{\partial T_i} = (\beta_0 + \beta_1 AI_s) exp[F(W)] \qquad (35)$$

We considered three alternative specification of the full model, respectively with (a) two different main effects and two different interaction terms, (b) two different main effects and one interaction term, (c) two different main effects and no interaction term.

For specification (a) we have that:

$$F(W) = \alpha_s + \beta_{01}(T_i \cdot d\tau_1) + \beta_{02}(T_i \cdot d\tau_2) + \beta_{11}(T_i \cdot AI_s \cdot d\tau_1) +$$

$$+ \beta_{12}(T_i \cdot AI_s \cdot d\tau_2) + \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \qquad (36)$$

where τ_1 ranges from $\tau_1 = 16$ to $\tau_1 = 85$ and $\tau_2 = 1 - \tau_1$and the marginal effect of taxes is:

$$\frac{\partial y_{is}}{\partial T_i} = \{\beta_{01} d\tau_1 + \beta_{02} d\tau_2 + \beta_{11}(AI_s \cdot d\tau_1) + \beta_{12}(AI_s \cdot d\tau_2)\} exp[F(W)] \qquad (37)$$

For specification (b) we have that:

$$F(W) = \alpha_s + \beta_{01}(T_i \cdot d\tau_1) + \beta_{02}(T_i \cdot d\tau_2) + \beta_1(T_i \cdot AI_s) + \gamma\left(y_{is,-1}\right) +$$

$$+ \delta X_i + \eta Z_{is} + \varepsilon_{is} \qquad (38)$$

and the marginal effect is:

$$\frac{\partial y_{is}}{\partial T_i} = \{\beta_{01} d\tau^1 + \beta_{02} d\tau^2 + \beta^1 (T_i \cdot AI_s)\} exp[F(W)] \quad (39)$$

Lastly for specification (c) we have that

$$F(W) = \alpha_s + \beta_{01}(T_i \cdot d\tau_1) + \beta_{02}(T_i \cdot d\tau_2) + \gamma\left(y_{is,-1}\right) + \delta X_i + \eta Z_{is} + \varepsilon_{is} \quad (40)$$

and the marginal effect is:

$$\frac{\partial y_{is}}{\partial T_i} = \{\beta_{01} d\tau_1 + \beta_{02} d\tau_2\} exp[F(W)] \quad (41)$$

1.5 Results

1.5.1 Polynomial and spline regressions with sector fixed effects

We start by re-estimating the linear specification as in BJS[13], using municipal control variables and sector fixed-effects. The only difference to the BJS's estimates is that we use the cumulative ordinal EG-index (PEG). Results are presented in column 1 of Table 1.2 and Figure 1.4. Addressing the skewness of the original EG-index implies that, in the linear specification, the interaction term of taxes and agglomeration is, while still positive, not significant anymore. Note that the main effect of taxes is, as expected, negative and significant. However, Figure 1.4 shows that there is still an important range of degrees of agglomeration where taxes have a significantly negative impact on firm location.

In the reminder of Table 1.2 we present specifications using polynomial and spline regressions, thus allowing for non-linearities, but not jumps. Column 2 uses a second order polynomial specification, while column 3 a fourth order one. In both specifications the main effect is negative and highly significant, again implying that, with no spatial sectoral agglomeration, taxes exert strong deterrence to firm location. Similarly, both in column 2 and 3 of Table 1.2, the first two orders (linear and squared term) of the polynomial are positive and significant, while in column 3 the third and fourth order polynomial are not

[13] Cf. Table 1.2 and Figure 1.6 of BJS.

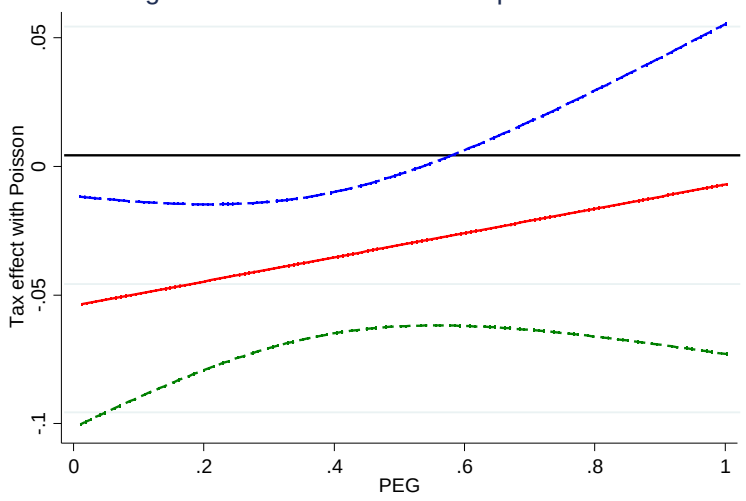
significant. However, as illustrated by the F-test on joint significance, all polynomial terms are jointly significant.

Table 1.2 - Poisson base, polynomial and spline regressions with interactions

	Dep. var. = new firms per municipality and sector				
VARIABLES	Base, PEG	2nd Poly, PEG	4th Poly, PEG	VARIABLES	Spline 5, PEG
	(1)	(2)	(3)		(4)
Tax	-0.0583**	-0.0199**	-0.0229**	Tax	-0.00555
	(0.0232)	(0.00953)	(0.00995)		(0.0393)
Tax × PEG Index	0.0488	0.0340***	0.0349***	Tax × k_1(PEG Index)	-0.254
	(0.0481)	(0.00959)	(0.00954)		(0.241)
Tax × (PEG Index)^2		0.0364***	0.0382***	Tax × k_2(PEG Index)	0.337
		(0.00956)	(0.00829)		(0.375)
Tax × (PEG Index)^3			0.0125	Tax × k_3(PEG Index)	-0.273
			(0.00903)		(0.326)
Tax × (PEG Index)^4			0.00215	Tax × k_4(PEG Index)	0.574*
			(0.00754)		(0.345)
				Tax × k_5(PEG Index)	0.360
					(0.445)
Wage	-0.505***	-0.484***	-0.479***		-0.479***
	(0.0927)	(0.0813)	(0.0805)		(0.0832)
Stock of firms	0.000108**	0.000114**	0.000118**	Stock of firms	0.000116**
	(5.45e-05)	(5.45e-05)	(5.62e-05)		(5.78e-05)
Wage × Aggl. Index	0.0686	-0.0190	-0.0408		-0.0394
	(0.181)	(0.183)	(0.193)		(0.195)
Property price × A.I.	1.192**	1.315**	1.333**		1.331**
	(0.487)	(0.545)	(0.548)		(0.550)
Municipal controls	YES	YES	YES	Municipal controls	YES
Sector FE	YES	YES	YES	Sector FE	YES
Observations	28,116	28,116	28,116	Observations	28,116
Number of sectors	132	132	132	Number of sectors	132
F-test on Tax × (PEG)^i		19.97	29.17	F-test on Tax × k_i(PEG)	29.38
Prob > Chi2		0.000	0.000	Prob > F	0.000

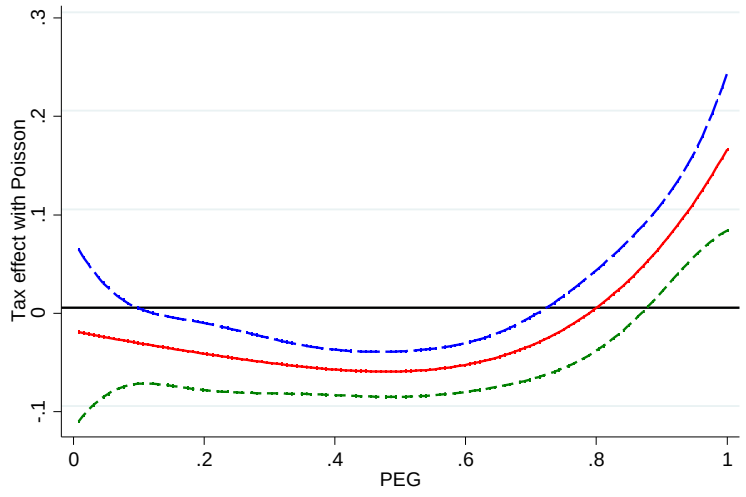
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1.4 - Poisson baseline specification



The higher order positive coefficients imply that the deterrence effect of taxes is reduced, at an increasing rate, with a higher level of agglomeration. This is illustrated in Figure 1.5, using the specification with the 4th order polynomial[14].

Figure 1.5 - Poisson polynomial estimation (4th degree)



We can observe that the effect of taxes on firm location is essentially flat and (significantly) negative up to around the 60th-percentile of the distribution. Shortly after the median of the distribution (point 0.5 of the PEG) there is an inflection point in the

[14] We estimated 2nd, 3rd and 4th degree polynomial specification. The qualitative results is the same for the three specification; we show the result for the 4th degree because it is the most visually clear one.

slope of the tax effect. This implies that, for the fifth quintile of the distribution of agglomeration, taxes essentially do not play a role for firm location. Indeed, for the most agglomerated sector, taxes have a positive effect on firm location.

Finally, in column 4 of Table 1.2 we present spline regressions, including five splines over each quintile of the PEG-distribution[15]. Note that, individually, only the spline term over the fourth quintile is significant and positive. However, jointly all the terms are highly significant (see F-test at the bottom of the column). The spline regression implies a relatively flat and negative effect of taxes, with an inflection point in the relationship for the fourth quintile and an essentially zero effect of taxes for the most agglomerated sectors.

1.5.2 Percentile regressions with sector fixed effects

We next allow for structural breaks in the relationship between taxes and sectoral agglomeration, using quintile and decile regressions. The results are presented in Table 1.3.

Column 1 shows the regression using quintiles over the agglomeration index (PEG). We can observe that, as before, the main effect of taxes is negative and significant. Interestingly, the only interaction term individually significant (and positive) is the one for the fifth quintile. Results are similar when estimating the interaction terms over deciles, in which case only the ninth and tenth percentile terms are significant.[16]

Figure 1.6 illustrates these results for the quintile regression. Note that the tax effect is essentially flat and negative over the first four quintiles of the PEG-distribution. One can detect a slight inflection in the tax effect for the fourth quintile, but the jump is not significant. However, the tax effect is starkly different for the most agglomerated sectors, where it actually turns positive.

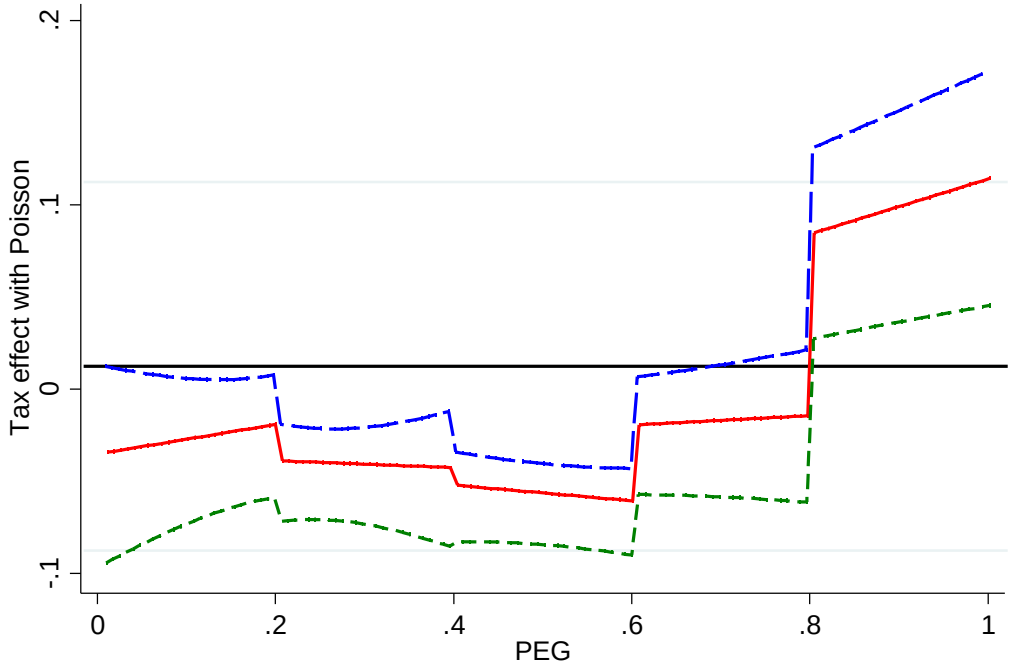
[15] The results using ten spline terms are qualitatively similar and available upon request.
[16] However, the main effect is, albeit negative, not significant anymore.

Table 1.3 - Poisson percentile regressions with interactions

Dep. var. = new firms per municipality and sector			
VARIABLES	Quintiles of PEG (1)	VARIABLES	Deciles of PEG (2)
Tax rate	-0.0474*	Tax rate	-0.0695
	(0.0288)		(0.0540)
Tax × Aggl. Index × q_1(PEG)	0.0850	Tax × Aggl. Index × d_1(PEG)	0.653
	(0.117)		(0.647)
Tax × Aggl. Index × q_2(PEG)	-0.0145	Tax × Aggl. Index × d_2(PEG)	0.207
	(0.101)		(0.239)
Tax × Aggl. Index × q_3(PEG)	-0.0381	Tax × Aggl. Index × d_3(PEG)	0.0740
	(0.0512)		(0.214)
Tax × Aggl. Index × q_4(PEG)	0.0307	Tax × Aggl. Index × d_4(PEG)	0.0679
	(0.0483)		(0.166)
Tax × Aggl. Index × q_5(PEG)	0.154***	Tax × Aggl. Index × d_5(PEG)	0.0605
	(0.0444)		(0.112)
		Tax × Aggl. Index × d_6(PEG)	-0.00373
			(0.0950)
		Tax × Aggl. Index × d_7(PEG)	0.0380
			(0.0849)
		Tax × Aggl. Index × d_8(PEG)	0.0725
			(0.0786)
		Tax × Aggl. Index × d_9(PEG)	0.146**
			(0.0614)
		Tax × Aggl. Index × d_{10}(PEG)	0.191***
			(0.0654)
Wage	-0.486***	Wage	-0.477***
	(0.0830)		(0.0845)
Stock of firms	0.000120**	Stock of firms	0.000125**
	(5.65e-05)		(5.83e-05)
Wage × Aggl. Index	-0.0198	Wage × Aggl. Index	-0.0430
	(0.195)		(0.195)
Property price × A.I.	1.313**	Property price × A.I.	1.323**
	(0.544)		(0.545)
Municipal controls	YES	Municipal controls	YES
Sector FE	YES	Sector FE	YES
Observations	28,116	Observations	28,116
Number of sector	132	Number of sectors	132
F-test on Tax × PEG × q_i(PEG)	23.22	F-test on Tax × PEG × d_i(PEG)	67.61
Prob > Chi2	0.000	Prob > Chi2	0.000

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1.6 - Poisson quintile regression



1.5.3 Regressions with sector and municipal fixed effects

When estimating equations (28), (30) e (32) including sector and municipal fixed effects we do not obtain the main effect of taxes anymore. Table 1.4 presents these results applying the same specifications as before, i.e. polynomial, spline and percentiles, while Figure 1.7 illustrates them.

The results are consistent with the ones presented above. In column (2) and (3) we present 2nd and 4th order polynomials. Note that the linear and squared terms are highly positive and significant in both specifications. In the 4th order polynomial, all terms are jointly significant (see F-test at bottom of the column).

Similarly, the five-step spline results in only the fourth spline term to be positive and significant, again as in the specification without municipal fixed effects. Finally, using quintiles of the agglomeration index, we obtain anew that the interaction for the fourth and fifth quintiles are positive and statistically significant.

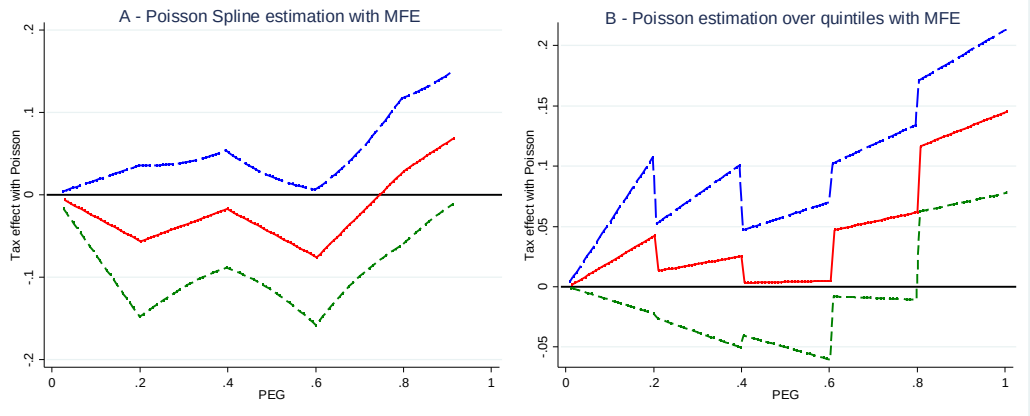
Overall, these results confirm our findings from above. A relatively flat effect of taxes for a large range of sectoral agglomeration, with a strong and positive interaction term for the most agglomerated sectors.

Table 1.4 - Poisson polynomial, spline, and quintile regressions with sector and municipal fixed effects with no interactions

	Dep. var. = new firms per municipality and sector					
VARIABLES	2nd Poly, PEG	4th Poly, PEG	VARIABLES	Spline 5, PEG	VARIABLES	Quintiles of PEG
	(1)	(2)		(3)		(4)
Tax × PEG Index	0.0169**	0.0193***	Tax × k_1(PEG Index)	-0.312	Tax × A.I. × q_1(PEG)	0.189
	(0.00661)	(0.00640)		(0.239)		(0.164)
Tax × (PEG Index)^2	0.0265***	0.0262***	Tax × k_2(PEG Index)	0.482	Tax × A.I. × q_2(PEG)	0.0353
	(0.00763)	(0.00650)		(0.369)		(0.0990)
Tax × (PEG Index)^3		0.00437	Tax × k_3(PEG Index)	-0.517*	Tax × A.I. × q_3(PEG)	-0.0271
		(0.00788)		(0.306)		(0.0593)
Tax × (PEG Index)^4		-0.00251	Tax × k_4(PEG Index)	0.866**	Tax × A.I. × q_4(PEG)	0.0427
		(0.00798)		(0.347)		(0.0478)
			Tax × k_5(PEG Index)	-0.306	Tax × A.I. × q_5(PEG)	0.0984***
				(0.375)		(0.0317)
Wage	0.0121	0.00888	Wage	0.0133	Wage	0.0114
	(0.0950)	(0.0948)		(0.0958)		(0.0952)
Stock of firms	0.000196**	0.000200**	Stock of firms	0.000198**	Stock of firms	0.000205**
	(9.03e-05)	(9.40e-05)		(9.67e-05)		(9.60e-05)
Observations	28,116	28,116	Observations	28,116	Observations	28,116
Number of sector	132	132	Number of sector	132	Number of sector	132
F-test on Tax × (PEG)^i	27.45	38.50	F-test on Tax × k_i(PEG)	49.39	F-test on Tax × A.I. × q_i(PEG)	50.02
Prob > Chi2	0.0000	0.0000	Prob > F	0.0000	Prob > Chi2	0.0000

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1.7 - Spline and quintile regressions with municipality fixed effects



1.6 Discussion of results

What do our results imply? One possible interpretation of our results above is that taxes have a deterrent effect on firm location for a large range of sectoral agglomeration (up to the fourth quintile), but that taxes play a much reduced or essentially no role for firm location in the most agglomerated sectors. Hence, taking the above results seriously implies that there seem to be two types of sectors, depending on the degree of agglomeration forces present. For the majority of sectors, taxes have a negative influence on firm location, while for the most concentrated ones, agglomeration forces may outweigh taxation concerns. This follows quite nicely the classification of sectors in NEG-models, sectors with constant returns to scale that "behave" according to the standard neo-classical theory of tax competition, and increasing returns to scale sectors, where taxes play a minor role. This also implies that there might be a threshold of the degree of agglomeration where the tax effect starkly changes. This result has guided our research strategy in what follows.

We performed a Quandt test over specifications (a), (b), and (c) (i.e. eq. 36, 38 and 40). The test – whose results are shown in Figure 1.8 – exhibit a peak at the 82nd percentile of the PEG index. The implied marginal effects for specification (a) and (b) are shown in Figure 1.9, respectively.

Figure 1.8 - Repeated Chow Tests

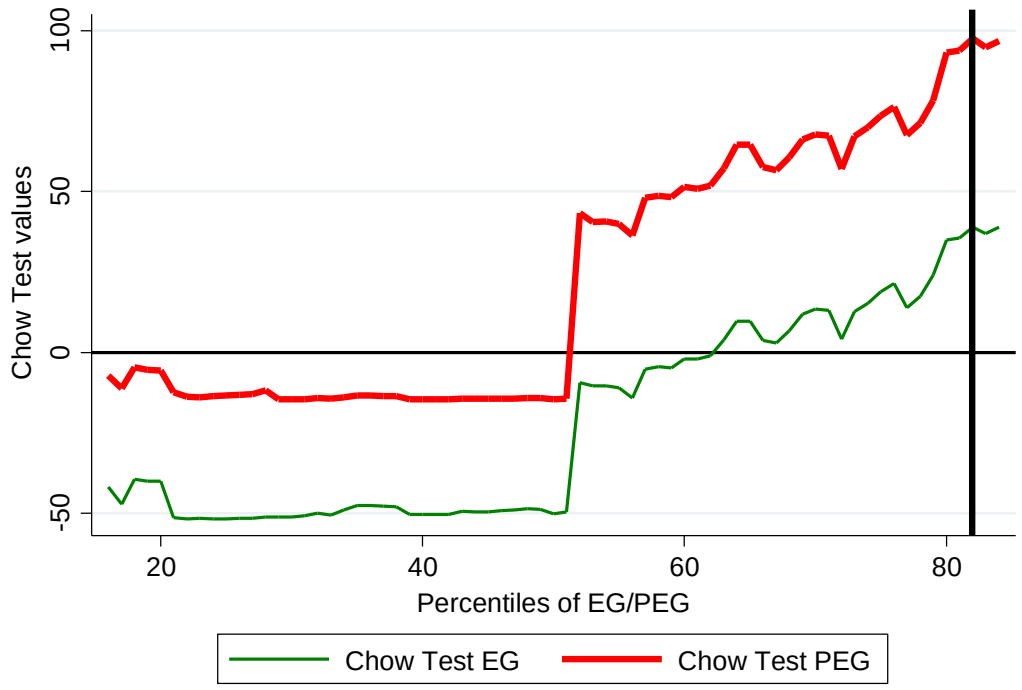
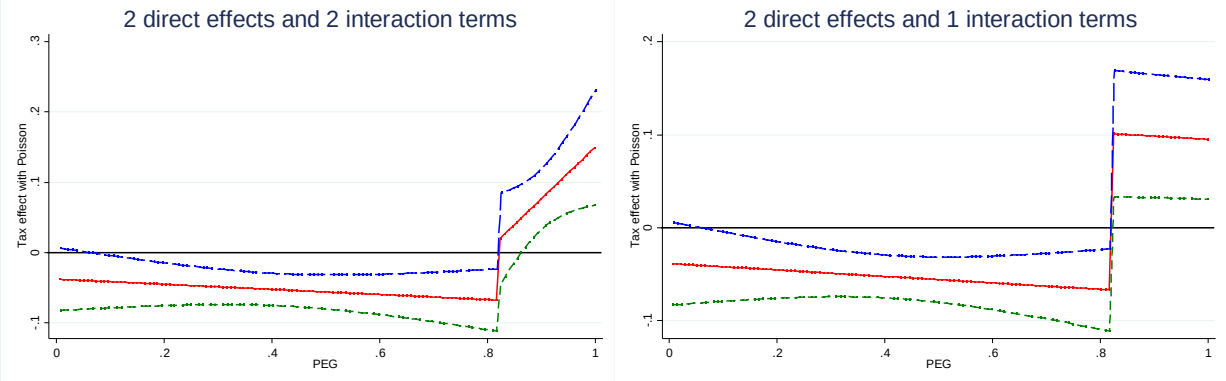


Figure 1.9 - Structural break



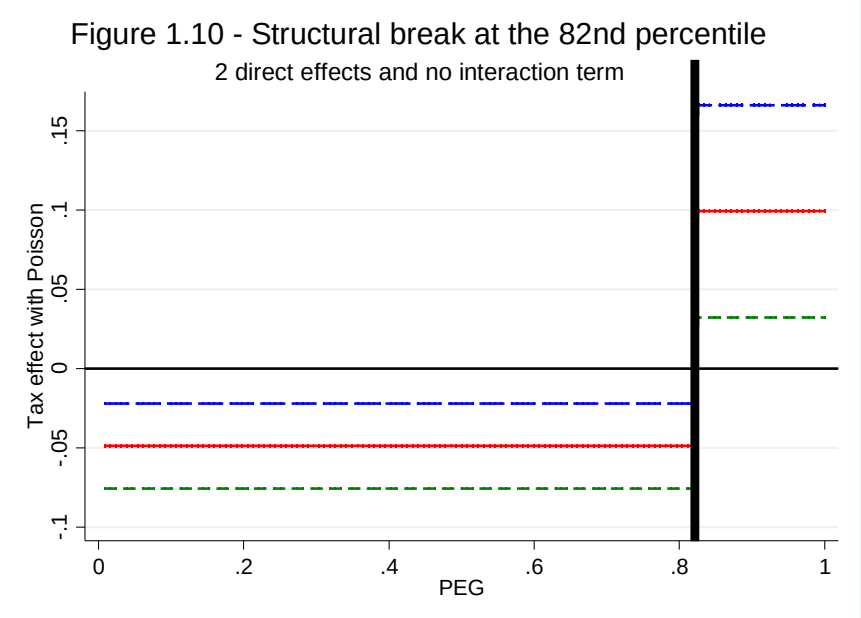
The discontinuity at the 82nd percentile is clear in both cases. However, the sharpest results emerges with respect to specification (c), whose results at the 82nd percentile are shown in Table 1.5, both for the EG and the PEG index. Both segments are strongly significant: we find a negative effect of taxes on firm location for less agglomerated sectors; instead, the coefficient becomes positive (and significant) for the most agglomerated sectors. The significance of the discontinuity is highlighted by the non-intersection of the confidence intervals for the two segments as shown in Figure 1.10.

Table 1.5 - Poisson estimation over two sections

VARIABLES	Dep. var. = new firms per municipality and sector Full sample - Break point at the 82nd percentile AI = EG (1)	 AI = PEG (2)
Tax × s_1(AI)	-0.0493***	-0.0488***
	(0.0138)	(0.0136)
Tax × s_2(AI)	0.0914***	0.0993***
	(0.0346)	(0.0341)
Wage	-0.518***	-0.483***
	(0.0853)	(0.0772)
Stock of firms	0.000130**	0.000116**
	(5.90e-05)	(5.40e-05)
Wage × Aggl. Index	2.447	-0.0309
	(1.553)	(0.197)
Property price × Aggl. Index	17.29**	1.351**
	(7.037)	(0.575)
Municipal controls	YES	YES
Sector FE	YES	YES
Observations	28,116	28,116
Number of sector	132	132
Chi2 on Tax × s_i(AI)	18.89	20.32
Prob > Chi2	0.0001	0.0000

s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 1.10 - Structural break at the 82nd percentile



It is now interesting to compare Figures 1.9 and 1.10 with Figure 1.2, which represents their theoretical counterpart: qualitatively speaking the result are very comparable, even if the structural break – the threshold $Z^c(\varphi)$ in our theoretical model – occurs around the median of the openness parameter. However, it is important to bear in mind that the distribution of the EG index is very skewed and hence we standardized it introducing the PEG, which assumes as its maximum the highest level of observed EG. This implies that the actual level of EG – despite being at the 82nd percentile of its cumulative distribution – is smaller when reported on a [0, 1] scale.

Finally, it is informative comparing the sectors right below the 82nd percentile threshold with the sectors right above. These sectors are listed in Tables 1.6 and 1.7 respectively. After computing the average of the effective corporate tax rates that they are subject to, we tested the null hypothesis that the difference between these averages is equal to zero. We are able to reject the null hypothesis at the 5% level of significance. This simple test provides further evidence of the discontinuity at work.

These results seem to be a reasonably convincing evidence of the behavior predicted by the core-periphery outcome: once a sector reaches a critical threshold it becomes – all of a sudden – insensitive to tax differential.

Table 1.6 - Sectors just below the PEG 82nd percentile threshold (only sectors with new firms)

Sector's name	Sector #	PEG	EG	Avg tax rate (tp9)	Stock of firms	New firms
Manufacture of motor vehicles and their engines	341	0.811	0.018	10.32	1	2
Manufacture of parts and accessories for motor vehicles and their engines	343	0.811	0.018	10.94	1	3
Manufacture of luggage, handbags and the like, saddlery and harness	192	0.803	0.018	10.77	22	7
Manufacture of office machinery, data processing devices	300	0.796	0.017	10.12	12	17
Manufacture of prepared animal feeds	157	0.788	0.017	9.71	3	3
Manufacture of basic precious and non-ferrous metals	274	0.773	0.016	8.46	5	6
Publishing	221	0.765	0.016	10.78	773	157
Sawmilling and planing of wood; impregnation of wood	201	0.765	0.015	7.54	2	2
Manufacture of machine-tools	294	0.758	0.015	10.32	24	9
Manufacture of plastic products	252	0.750	0.015	10.78	64	25
Manufacture of industrial process control equipment	333	0.742	0.015	9.96	19	16
Manufacture of other special purpose machinery	295	0.735	0.015	10.50	84	41
Average of Averages of tax rate				**10.02**		

Table 1.7 - Sectors just above the PEG 82nd percentile threshold (only sectors with new firms)

Sector's name	**Sector #**	**PEG**	**EG**	**Avg tax rate (tp9)**	**Stock of firms**	**New firms**
Central banking and banking	651	0.962	0.058	12.10	751	15
Manufacture of games and toys	365	0.955	0.052	11.34	13	11
Non-scheduled air transport	622	0.955	0.052	9.28	14	5
Letting of own property	702	0.947	0.044	10.62	110	31
Manufacture of watches and clocks	335	0.939	0.043	11.72	380	67
Manufacture of optical instruments and photographic equipment	334	0.932	0.042	11.24	22	14
Other financial intermediation	652	0.917	0.035	11.06	535	171
Renting of automobiles up to 3.5 t total weight	711	0.909	0.032	11.40	60	18
Reproduction of recorded media	223	0.902	0.030	11.15	8	6
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	323	0.894	0.029	10.94	12	9
Research and experimental development on social sciences and humanities	732	0.894	0.030	10.47	59	22
Activities of travel agencies and tour operators; tourist assistance activities n.e.c.	633	0.886	0.028	10.67	1575	289
Manufacture of aircraft and spacecraft	353	0.879	0.027	12.56	14	8
Manufacture of basic chemicals	241	0.871	0.025	11.15	2	5
Finishing of textiles	173	0.864	0.025	10.40	8	7
Manufacture of telecommunication appartus	322	0.856	0.023	9.78	7	6
Manufacture of footwear	193	0.849	0.022	11.06	2	5
Manufacture of other textiles	175	0.833	0.019	10.04	20	7
Production of agricultural and forest machinery	293	0.826	0.019	10.35	7	8
Insurance (except compulsory social security)	660	0.826	0.019	11.18	815	39
Average of Averages of tax rate				**10.93**		

1.7 Conclusions

Catastrophic agglomeration is a fascinating prediction of the NEG literature. Despite having been described as "perhaps the most celebrated feature of the core-periphery model"[17], it has always been mainly considered a theoretical curiosity so far. Head and Mayer (2004, p. 2662), have been very tough with it, arguing that "(c)atastrophes (...) should perhaps be considered more as fascinating theoretical 'exotica' rather than as robust elements of economic geography". Along the same line, Combes et al. (2008, p. 337) stated that the "studies undertaken to date seem to converge in invalidating the existence of phenomena such as catastrophes".

First, we generalize the result of the footloose capital model, deriving the general formula describing the sensitivity of the tax base to taxes at different levels of agglomeration economies.

Second, we use more flexible estimation techniques, to assess the sensitivity of new firms' birth to tax differentials depending on the level of observed sectoral agglomeration. Our analyses suggest that there are non-linearities in the response of new firms' birth to tax differential at different levels of the agglomeration of the sector considered. This evidence is robust to polynomial, spline and percentile specifications.

Third, to further validate these results, we performed a Quandt test for structural break, a technique more often used in time-series analyses. Consistently with our expectations from previous analyses, we find a structural break at the 82nd percentile of our cumulative measure of sector agglomeration. This result is also robust to the three types of specifications that we tested.

To our knowledge, this is the first attempt to empirically detect evidence of catastrophic agglomeration and our results hint that such discontinuous agglomeration forces may not be completely unrealistic.

[17] Baldwin et al. (2003, p. 35)

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Stop invasion! Immigrants and the rise of populism in Europe [1]

with Massimo Bordignon, *Catholic University of Milan and CIFREL*
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2.1 Introduction

There is a vast debate all over Europe on the rise of right-wing anti-immigrant parties. The Front National in France, the Dutch Freedom Party in the Netherlands, the Freedom Party of Austria (FPÖ), the United Kingdom Independence Party (UKIP) in the UK and the Northern League (NL) in Italy - to name a few examples - have gained significant support over the last years. Presumably, they took advantage of the increasing pressure of

[1] We are very grateful to Éupolis Lombardia for giving us access to the very rich dataset this research is based upon and to Guglielmo Barone who gave us some historical data on immigrants' past settlement that are no longer available. We thank Massimo Filippini, Patricia Funk, Mario Jametti, Giuliano Masiero, Giovanni Pica, Raphaël Parchet and all other researchers at IdEP (USI) for enduring and tireless support and advices. We also thank Maria de Paola, Paolo Naticchioni, Fabrizio Patriarca and the other participants at the CIRET conference in Rome in May 2017, as well as Francesco Fasani and Libertad Gonzalez for valuable comments.

immigrants' flows combined with the aftermath of a long crisis and slowly recovering economies.

A wide and fastly growing literature has studied the effect of immigration on the support for extremist parties. Even if the majority of researchers find a positive effect of immigration on the success of right-wing parties, the empirical evidence is mixed. A positive effect has been found in Denmark, Germany, Austria and Italy[2]. However, Steinmayr (2016) finds a negative effect of refugees on the FPÖ vote share. Mendez and Cutillas (2014) do not identify any significant effect on support for the anti-immigrants coalition in Spain, even though they find a positive effect for African immigrants. Becker and Fetzer (2016) find that immigration in the UK has fostered the support for UKIP, while Levi et al. (2017) argue that it has only had a short-run positive effect on Brexit and UKIP's support, which vanishes over time.

Nevertheless, the literature has not investigated whether the votes for these anti-immigrant parties are mainly ideologically driven or if there is also a rational component based on economic factors. Indeed, there might be two economic explanations due to the heterogeneity of immigrants relative to natives: (1) the fear of a possible crowding out effect in social services and public goods[3]; (2) the concern of a possible competition of the immigrants on the labor market[4].

Our paper investigates the existence of these two economic channels, by exploiting a very rich dataset on Lombardy. An important and interesting feature of this setting is the negative political cycle that the Northern League was undergoing at the time of elections. Despite the negative electoral cycle, the Northern League put immigration at the core of its electoral campaign, drawing great attention on the topic especially in the days around the elections (see Figure 2.1).

Moreover, the fortuitous occurrence of a contemporaneous election at the national and regional level allows us to investigate whether people react differently to various types of elections[5]. Thanks to a unique - recently released - dataset, we contribute to the existing

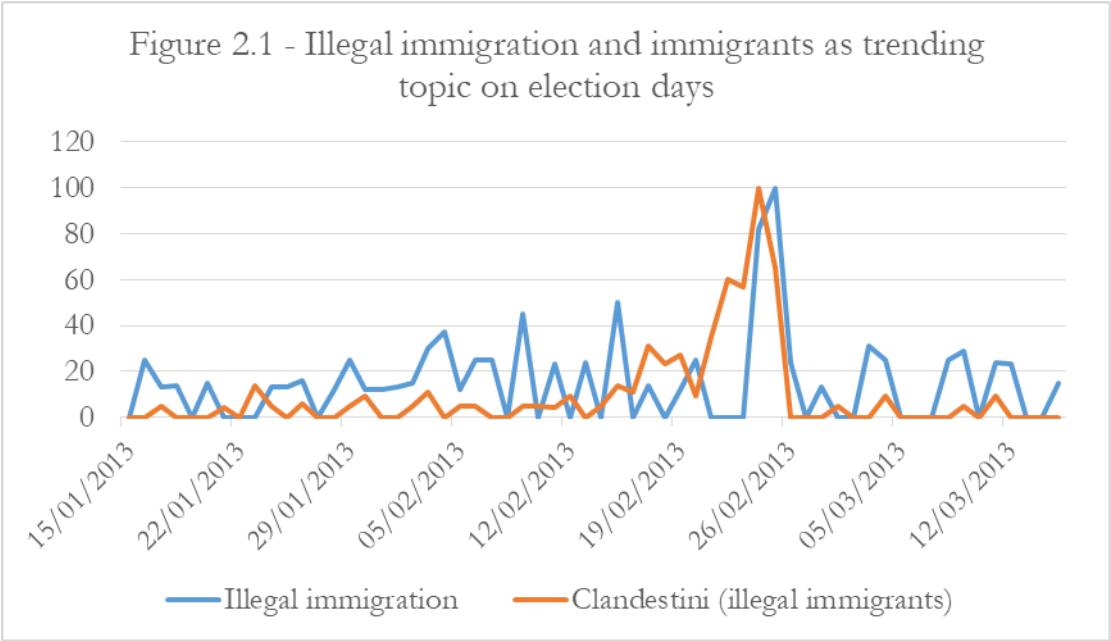
[2] Düstmann et al. (2016), Harmon (2015), Gerdes and Wadensjo (2010) in Denmark; Otto and Steinhardt (2014) in Germany; Halla et al. (2016) in Austria; Barone et al. (2014) in Italy.

[3] Alesina et al. (2001); Alesina and La Ferrara (2000); Alesina et al. (1999).

[4] Longhi, Nijkamp and Poot (2005); Blau and Kahn (2012); Lewis and Peri (2015).

[5] In general, the national and regional elections are not contemporaneous. This coincidence occurred because the Lombardy regional government fell before the end of its term. More details will be provided in section 4.

literature accounting for income (and tax) differentials between immigrants and Italians[6] at the municipal level.



We start from the premise that the ideological component of the support for the NL should be invariant across different levels of government. The rational component of the support for the NL, instead, should differ between the national and regional elections, since the competences of the national and regional governments are different and distinct. In fact, the national government manages the planning of the incoming immigration flows and the residence policies on the national territory, while the regional government has competence on welfare, education, health care and housing of the immigrants. Hence, if the economic differences of the immigrants relative to the Italians are important to explain voters' behavior, we can argue that voters are not necessarily anti-immigrant per se, but there might be two additional explanations. On one hand, the Italians might not want to pay services or social security measures that benefit primarily the immigrants (a heterogeneity argument à la Alesina, 2001), but on the other hand they might fear the competition of immigrants in the labor market.

Lombardy constitutes a good socio-economic context for our analyses, having the highest share of immigrants in its population and being amongst the ones with the highest

[6] We carefully avoid the use of the word "natives" because here the discriminating factor is the citizenship, which also gives the right to vote. The number of non-natives who have gotten the Italian citizenship in Lombardy now exceeds two hundred and twenty thousand individuals, about 20% of the current number of immigrants.

support for the Northern League. It is also the richest and most populated Italian region. Our setting does not allow us to estimate precisely the crowding out and the labor-market competition effects, but – given that they operate in opposite directions – we are able to understand which one dominates in shaping voting behavior.

Our results show that the difference in median incomes – between Italians and immigrants – has a positive effect on the NL electoral outcomes, but the interaction between that difference and the share of immigrants has a negative and stronger effect. The cumulated effect suggests that the labor-market competition effect is thus stronger than the crowding out one. We address endogeneity issues using a Card-instrument following the methodology suggested by Barone et al. (2014).

The paper is organized as follows: section 2.2 reviews the existing literature; section 2.3 details the three – one ideological and two economic – channels through which immigration might foster the support for right-wing parties or coalitions; section 2.4 explains the features of the institutional setting; section 2.5 introduces the data at hand; section 2.6 describes the basic empirical model and section 2.7 presents the main results; section 2.8 concludes.

2.2 Literature review

The impact of immigration on the electoral success of right-wing parties (or coalitions) has been recently analyzed by many scholars, in Denmark, Germany, Austria, Spain, UK and Italy. Dustmann et al. (2016) analyze the causal effect of refugee migration on voting outcomes at the national and municipal elections in Denmark. They find that the allocation of larger shares of refugee leads to an increase in the vote share for both anti-immigrant parties and center-right parties at large. However, there are heterogeneous effects depending on municipal characteristics, especially along the line urban vs non-urban municipalities. Refugee allocation influences voter turnout and positioning of anti-immigrant parties in municipal elections, too.

Gerdes and Wadensjo (2010) assess the effect of the inflow of refugees on electoral outcomes in Denmark at the municipal level. Their analysis - covering the period from 1989 to 2001 - shows that the shares of refugees is positively associated with the two main anti-immigration parties. Harmon (2015) also investigates the voting behavior among

Danes, focusing on immigrants. He finds a positive association between immigrant shares and right-wing parties' electoral outcomes.

Otto and Steinhardt (2014) analyze the effect of immigration inflows in 103 districts in the city of Hamburg and argue that an increase in the share of immigrants entails an increase in the share of votes of extreme right-wing parties in both federal state and national elections.

Halla et al. (2016) analyze whether immigration positively affect the votes for the Freedom Party of Austria (FPÖ), a party with a clear anti-immigration stance. They find that a 1% increase in the share of immigrants in a municipality increases the FPÖ votes in general elections by about 0.35%. Steinmayr (2016) also focuses on the FPÖ using the availability of appropriate housing as an instrument to assess how having received any refugees affected the response of voter shares in the 2016 state elections. Unlike all the other analyses, he shows that hosting refugees decreases the FPÖ vote share.

Mendez and Cutillas (2014) study the effect of immigration in Spain on the outcome of the national elections from 1996 to 2011, a period in which the immigrant share rose sharply. They find that immigration inflow has no significant effect on support for anti-immigration coalitions. However, splitting the immigrant incidence by nationality, they identify a positive impact of African immigrants on anti-immigration coalitions.

Edo et al. (2018) analyzing the French presidential elections between 1988 and 2017 find that immigration inflows has a positive effect on the support for the far-right candidates, especially if immigrants are non-educated and come from non-EU countries. In contrast to their results, Vertier and Viskanic (2018) find a negative effect on the increase of the support for the Front National in the presence of temporary migrant-centers.

Becker and Fetzer (2016) evaluate the electoral success of UKIP at the European Parliament elections following the 2004 accession of eight Eastern European countries (plus Cyprus and Malta) to the European Union. They display that the significant immigration inflow from these new EU members has depressed wages at the lower tail of the wage distribution and accrued pressure on public services and housing. Partially in contrast to these results, Levi et al. (2017) find that the higher support for UKIP and Brexit resulting from an increased immigrant presence is only temporary. Over time, the effect of new immigrant inflows on voting behavior progressively vanishes.

Tabellini (2017) assesses opposition to immigration in the US, even if it is economically beneficial, pushing natives' employment towards better types of jobs and fostering industry

productivity and capital utilization. As a reaction, there was a decrease in tax rates and public spending and a decrease in the support for the more immigration-favorable party (i.e. the Democrats). Mayda et al. (2018), analyzing the US between 1990 and 2010 find that high-skilled immigrants' inflow reduced the support for the Republicans, while low-skilled immigrants' inflow fostered it. They also register a stronger effect among non-urban areas and low-skilled workers, mainly due to the fear of an increasing competition on the labor market.

Barone et al. (2014) point their attention to the electoral outcomes of the center-right coalition at the municipal level for the 8000 Italian municipalities: they discover that 1% increase in the share of immigrants of a municipality is associated with a 0.86% increase in the share of votes going to the center-right coalition. The authors also identify heterogeneous effects across municipality size, a decrease in voter turnout, an increase in protest votes and an effect on mayoral elections.

The mayoral election itself might affect the inflow of immigrants as pointed out by Bracco et al. (2017): immigrants' location choices are affected by the presence of NL mayors. Immigrants do not flee out from NL ruled towns, but they tend to avoid moving towards municipalities with a NL mayor.

Gebremedhin and Mavisakalyan (2013) highlight how the two economic channels – crowding out of social services and competition in the labor market – can reinforce the support for anti-immigrant parties. The success of these parties can – in turn – lead to an increased political instability and a subsequent increase in military spending.

Cattaneo et al. (2013) investigate the labor-market competition channel using a panel for the EU-15 countries. They find that when there is an immigrant inflow in a labor-market the natives increase their probability of moving to higher-skills jobs. Moreover, this does not cause a variation in natives' unemployment. Therefore, immigrants move the natives towards better career paths, which, with a lag of 1-2 years, result in an increase in wage incomes. This result is also in line with what Foged and Peri (2015) observe for Denmark: refugees inflows push the natives to pursue less manual-intensive occupations. The end outcome is an increase in the wages, employment and occupational mobility of native unskilled workers. Peri (2012) also finds that immigrants do not crowd-out employment, but, instead, have a positive effect on total factor productivity and promote the adoption of unskilled-efficient technologies.

The literature seems then to suggest that all these three transmission channels – ideological, crowding out and labor-market competition – point in the same direction. However, this is not so clear-cut: as soon as we take into account the heterogeneity and mix of skills and incomes of immigrants and citizens, they might generate different outcomes, as we will explain in more detail in the following section.

2.3 Channels of transmission

We argue that immigration might affect electoral outcomes trough three main channels: (1) "ideological" anti-immigrant feelings; (2) crowding-out effect; (3) labor-market competition. As previously mentioned, a high share of immigrants not necessarily implies all the effects.

The "ideological" anti-immigrant feelings can be defined as the set of concerns caused by the native's worry of not being able to preserve effectively their own language, values norms and customs when facing significant waves of newcomers.

Allport (1954) defines prejudice as "a hostile attitude or feeling toward a person solely because he or she belongs to a group to which one has assigned objectionable qualities". These prejudices usually cannot be overcome by information and data. Particularly relevant are the ideas about groups: grouping people by religion, nationality, or race can give a person a faulty sense of identity and self-worth. However, Arrow (1971) argues that people turn to prejudice only when they have a lack of information about tradition, customs and habits towards the immigrants.

Castillo and Petrie (2010), in line with Arrow, find evidence of statistical discrimination, but only if race is the only available information. Once information is provided people start reacting differently, suggesting that the driver of such discrimination is more the lack of information than discriminatory preferences. Their results also suggest that a sufficient individual-level information about members of other groups could overcome discrimination.

The ideological effect of the immigration – fostered by prejudice and lack of knowledge – might be diluted over time as suggested by *contact theory* (Allport, 1954) in two different ways:

- natives might get to know immigrants after an adaptation period, as suggested by Levi et al. (2017)
- natives might get used to immigrants once the share of immigrants has passed a certain threshold.

From an empirical point of view, the two processes act differently: the former vanishes over time, starting from the time of arrival and can be captured by a time-specific term, the latter generates a non-linearity, hence – as long as the adaptation process is reasonably smooth – it can be captured by a polynomial term. Evidence of contact theory has been found by Savelkoul et al. (2011) and by Novotny and Polonsky (2011) with respect to the prejudices about Muslim immigrants in Europe.

The crowding-out effect and the labor-market competition can be summarized as "economic" channels. In this context, we define the crowding-out effect as the fear that poor and/or nonworking immigrants will benefit from the generous European welfare system, excluding the natives from the pool of potential beneficiaries. Natives might not necessarily fear to have to pay more taxes[7], but they could simply be worried that they will not be eligible anymore for some specific social benefits, such as the school canteen for their children, social housing, etc[8]. As pointed out by Boeri (2010), these types of concerns are relatively more widespread amongst the low-skilled natives.

Labor-market competition does not necessarily arise because of immigration inflows, as it crucially depends on the skill-mix of the immigrants relative to the natives. Card (2001) and Borjas (2003) find that immigrants put pressure on natives' wages where the supply of workers is relatively high in a given occupation. Dustmann et al. (2008) carefully assess how immigrants affect the labor market and in Dustmann et al. (2013) verify how newcomers depress wages for low-skilled natives, while slightly increasing them for high-skilled ones. The literature on natives' attitude towards immigrants (Sheve and Slaughter, 2001; Mayda, 2006; Facchini and Mayda, 2009; Card et al., 2012) highlights how natives perceive immigrants with comparable skill sets as generating more competition on the labor market.

An example could help to clarify both the crowding-out effect and the labor market competition. Consider an extreme situation in which the natives have very high skills and incomes and immigrants have very low skills and income. In this scenario, there will be no

[7] In Italy, for example, there is a cap to the tax rate of the surtax that a municipality can raise.
[8] Local governments might not be allowed to run public deficit (due to an internal stability pact at the national level, for example), hence the arrival of new poorer immigrants might actually exclude natives from the pool of beneficiaries.

crowding-out effect, because none of the natives would be eligible for welfare benefits in any case and no labor-market competition, because the job markets for immigrants and natives do not overlap. On the other extreme, in a situation in which natives and immigrants have very similar skill sets and incomes, there will be both crowding-out and labor-market competition, leading to strong frictions between the two groups. To summarize, the presence of crowding-out effect and labor-market competition critically depends on the relative skill mix of immigrants and natives.

2.4 Institutional setting

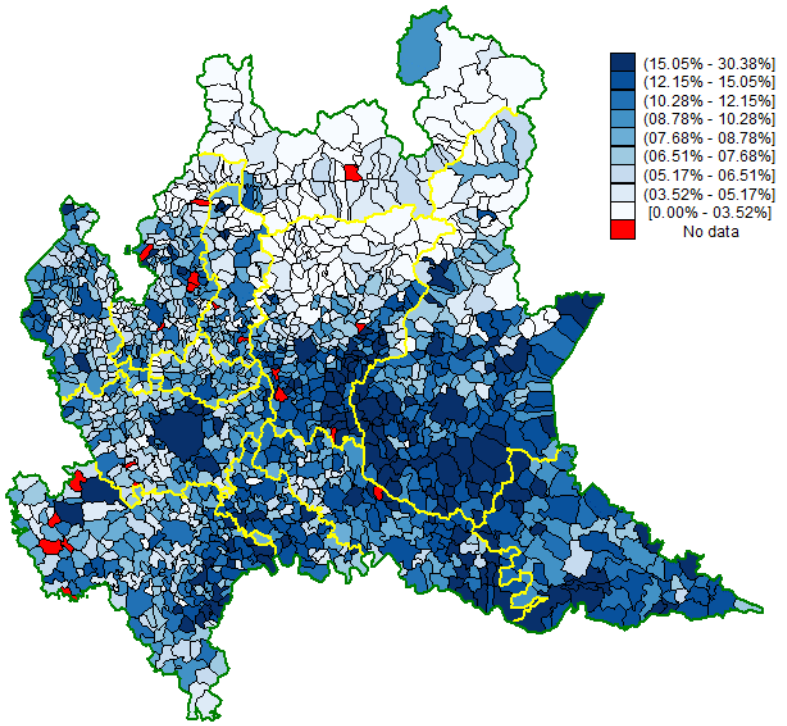
Italy is a parliamentary republic since 1946. In 1948, there had been the first national elections. The parliament is divided into two chambers: a lower one – the House – and an upper one – the Senate. The electoral rules are different between the House and the Senate. Even though they both follow a proportional rule with a majority premium, attributing 55% of the seats to the party/coalition with the highest share of votes, the conditions to get the majority premium are different between the two chambers. In fact, it is assigned at the national level for the House and at the regional level for the Senate. The electoral pools are also different: it is necessary to be at least 18 years old to vote for the House, but at least 25 years old to vote for the Senate. In general, the members of parliament stay in office for five years. However, eight times – out of seventeen – there have been anticipated elections, due to the fall of the government and the impossibility of finding a new majority in the parliament.

From 1948 to 1991, the Italian government has been supported by the Christian Democrats and later on, since the 1980s, by a coalition – called the "Pentapartito" (party of five) – led by the Christian Democrats. In 1992, under the pressure of many corruption accusations by a pool of judges based in Milan (the "Mani Pulite", clean hands, scandal), this party system went into crisis. By 1994, almost none of the historical Italian parties had survived. This is particularly important for our analysis, because the pre-1992 parties had no official stance on immigration, given that it was still a negligible phenomenon. Hence, their political ideas should not have affected in any way the location decision of the first wave of immigrants in 1991, to which we return below.

At the sub-national level, Italy is divided into 20 regions, 15 of which – established in 1970 – have an ordinary statute and five a special one. We focus our attention on Lombardy, the richest and most populated one. It is amongst the 15 ordinary ones and is divided into 12 provinces, which are mainly administrative entities and do not necessarily reflect the structure of the local economy. As a consequence, the Italian National Institute of Statistics (Istat) has identified 57 smaller local labor systems (henceforth LLS) which replicate quite precisely the labor markets. Lombardy is also the Italian region with the highest number of municipalities - 1544, as of 2013.

The region has an overall population of 10 million inhabitants and, as of 2012, a share of immigrants of about 12%, accounting for 23% of total immigrants resident in Italy. Immigrants are unevenly spread across municipalities, as it can be easily seen from Figure 2.2: some municipalities have no immigrants, while others have up to a 30% immigrants share. At first glance, their concentration is higher in the south-eastern part of the region and with a particularly high concentration in the provincial capitals.

Figure 2.2 - Municipal share of immigrants in 2012



Lombardy's electoral rule is quite simple, electing as regional governor the head of the party/coalition getting more votes on a regional basis. The list(s) connected to the winning candidate obtains 55% of the regional assembly seats if the elected governor gained less

than 40% of the votes and 60% of the seats if he received more than 40% of the votes. As a rule, each regional parliament stays in office for five years.

Since the first regional election in 1970, the regional assembly has always ended its term and, hence, there have never been contemporaneous elections both at the national and regional level in Lombardy. However, during the IX term, many members of the regional assembly were arrested for corruption. In October 2012, one of the parties composing the center-right majority, the Northern League (henceforth NL), withdrew its support to the regional government and the term ended in advance. As a result, for the first time, in 2013, there have been contemporaneous election at the national and regional level in Lombardy.

The Northern League was founded in 1989 and took part in the national elections in 1992 for the first time. Born as a political movement aimed at defending the rights of the northern regions, it rapidly turned into a right-wing party with a strong anti-immigrants stance. Over time, their opinions about immigrants became stronger and stronger: the title of the paper actually cites one of their electoral posters. Lombardy is currently led by a NL's governor. This makes it an interesting setting for our analyses on populism.

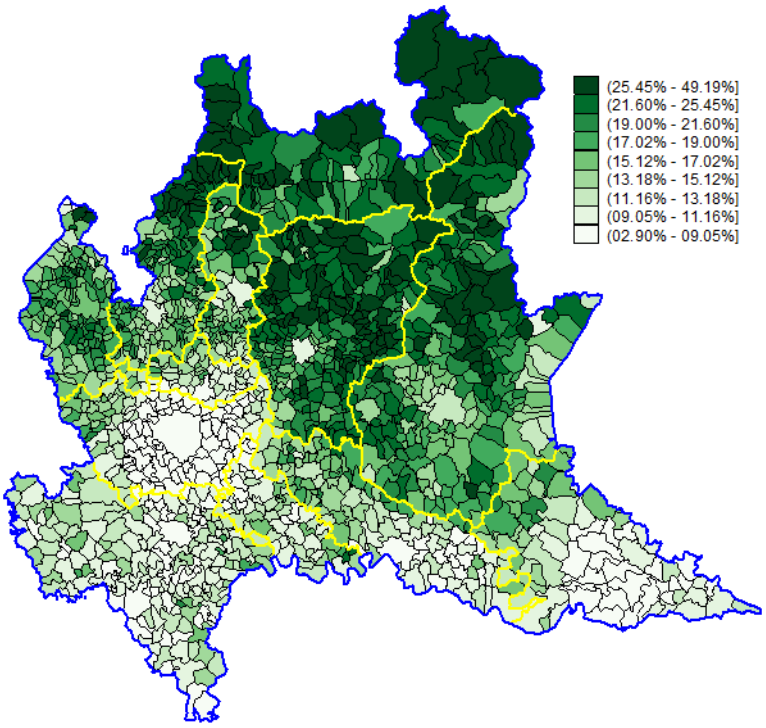
In 2013, as previously mentioned, Lombardy underwent both national and regional elections contemporaneously. Share of votes for the NL – at the municipal level – for the election of the House are shown in Figures 2.3: surprisingly, the highest share of votes to this party came from the municipalities with the lowest share of immigrants, despite a very strong anti-immigrant campaign from the NL. The municipalities voting the most for the NL are the ones located in the upper part of the region, with the exception of the province capitals. This result is in line with the contrast between urban and rural areas already highlighted by Düstmann et al. (2016).

The competences of the national and regional governments are different and distinct. The national government manages the planning of the incoming immigration flows and the residence policies on the national territory. Hence, the regional government cannot affect immigration as regards flows and residence permits. However, there are four main areas of competence of the regional government on immigration: welfare, education, health care and housing[9]. Thus, taking into account the different competences of the two levels of

[9] Many local administrators from the NL have tried to deny some welfare, education or housing related benefits to the immigrants, but they have not been very effective, given the obligations stated by the Italian Constitution and Constitutional Court.

government, and controlling for "ideology", the economic-based votes gained by the NL should be different at the national and regional level.

Figure 2.3 - Votes for the NL at the House, 2013



2.5 Data

Our dataset is a cross-section observing the outcomes of the national and regional elections at the municipal level that took place in Lombardy in 2013 and relating them to the immigration share as well as other relevant economic and demographic features. "Atlante storico delle elezioni" (Historical atlas of the elections, Ministry of Interior) provides the data on electoral outcomes of the national – for both the House and the Senate – and regional elections of 2013 at the municipal level. From these data, we extracted the share of votes received by the Northern League. The contemporaneity of these elections allows us to investigate whether the voters behaved differently when casting their votes for different levels of government. The Ministry of Interior also provides the results of the NL at the previous national and regional elections, in 2008 and 2010 respectively.

Data on immigration rely on two main sources: the ARCHIMEDE project by ISTAT - through Éupolis Lombardia[10] - and demo.istat, the demographic section of ISTAT. From the former we obtain the share of immigrants for 2012 and from the latter the stock of immigrants in 2007 and further immigrants' inflow until 2012.

The ARCHIMEDE dataset, despite being only a cross-section for 2012 is very detailed, comprising almost the entire universe of Lombardy residents, at the individual level, both Italians and immigrants. It consists of nearly 10 million individuals, clustered into roughly 4.4 million households. It relates the information coming from different sources: fiscal archives, chambers of commerce, social security archives, insurance archives and Ministry of Education archives. From this set of data, we computed several municipal-level variables that we used as explanatory and control variables. Specifically we were able to compute the average and median income by municipality for both Italians and immigrants, as well as their tax bills. Moreover, we were able to calculate the employment rate[11] – by Italian citizenship – at the Local Labor System level, the gender and age structure of the resident population and the share of college graduate.

From Éupolis Lombardia we also obtained data on the number of firms at the municipal level, from which we computed the per-capita number of firms by municipality.

To construct the instrument for the share of resident immigrants by municipality, we estimated (see section 2.6.1.2) the number of resident immigrants by municipality and country of origin based on their distribution in 1991 and 2003. Unfortunately, there was no data available about immigrants by nationality at the municipal level in 1991. Hence, combining the share of immigrants by continental area at the municipal level – provided by ISTAT – and data on residence permits by country of origin and nationality released by the Italian Ministry of Interior, we imputed immigrants at the municipal level according to the nationality breakdown at the provincial level[12].

Summary statistics for our dependent and independent variables are shown in Table 2.1. Data on the dependent variables refer to 2013 while the explanatory variables refer to 2012,

[10] We are very grateful to Éupolis Lombardia - the regional statistical office, for which we worked as consultants over the last three years - for granting us the access to this database.

[11] We prefer to use the employment rate relative to the unemployment one. There are two reasons for this: (1) in times of high unemployment, the unemployment rate is often not particularly informative of the well being of the economy, because of a high share uf discouraged unemployed; (2) the unemployment measure of the dataset at hand does not match the official unemployment statistics because of different definitions.

[12] A clear example of this estimation technique is provided by Barone et al. (2015), footnote 9.

unless otherwise stated. Starting from a cross-section database with 1544 observations, we had to drop 27 municipalities (26 were miscoded observations and one was an outlier[13]).

The share of votes of the NL is, on average, above 15%, but with shares ranging from 0% up to more than 50%. Figure 2.4 shows how the difference between the share of votes between the House and regional elections ranges from -17% and 21% of the votes. It delivers a more homogeneous result across provinces (excluding the province of Sondrio). We do not consider the House-Senate and Senate-Region difference because the composition of the electoral pool is different for the elections of the Senate (only citizens above 25 years old can vote).

The share of immigrants ranges from zero to 30% and its change has been computed between 2007 and 2012, the five years' time span before the elections. Income is defined as gross taxable income according to the definition of the personal income tax. Figures 2.5 and 2.6 show the heterogeneous distribution of the average incomes of the Italians, and the difference in median incomes between Italians and immigrants, respectively. The employment rate is defined as the share of people having worked in the last 12 months and not having received any unemployment benefit, both at the LLS and municipal level. Despite having almost the same average, the overall employment rate at the LLS level varies between 40% and 73% (see Figure 2.7), while the municipal employment rate of the Italians ranges from 12% up to 80%, with a much higher variance.

[13] In one municipality there was a resident immigrant with a very high income, which – given the smallness of the municipality – generated a very high average income of the immigrants relative to the Italians and a very high and negative difference between the average income of the Italians and the immigrants.

Figure 2.4 - Delta votes for the NL: House vs Region, 2013

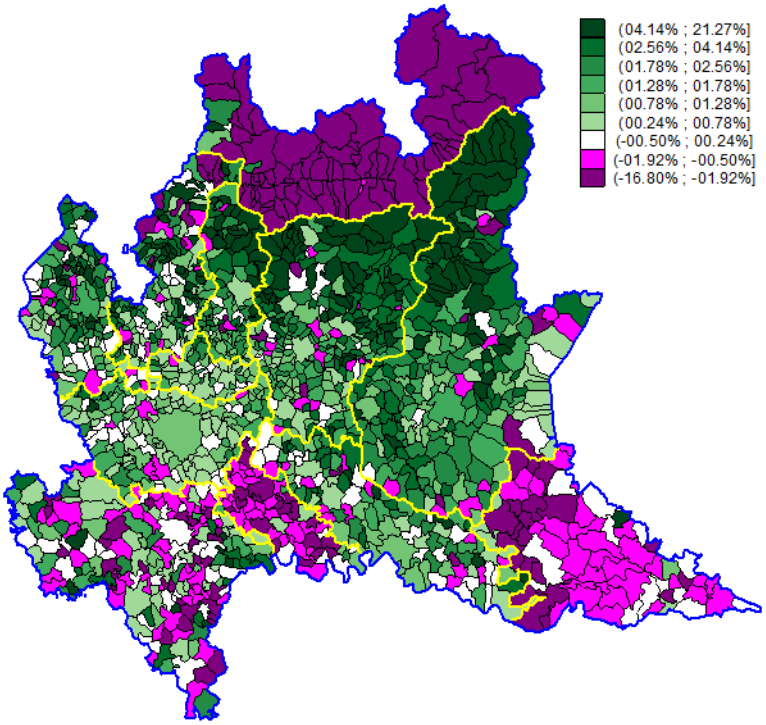


Figure 2.5 - Average incomes of the Italians, 2012

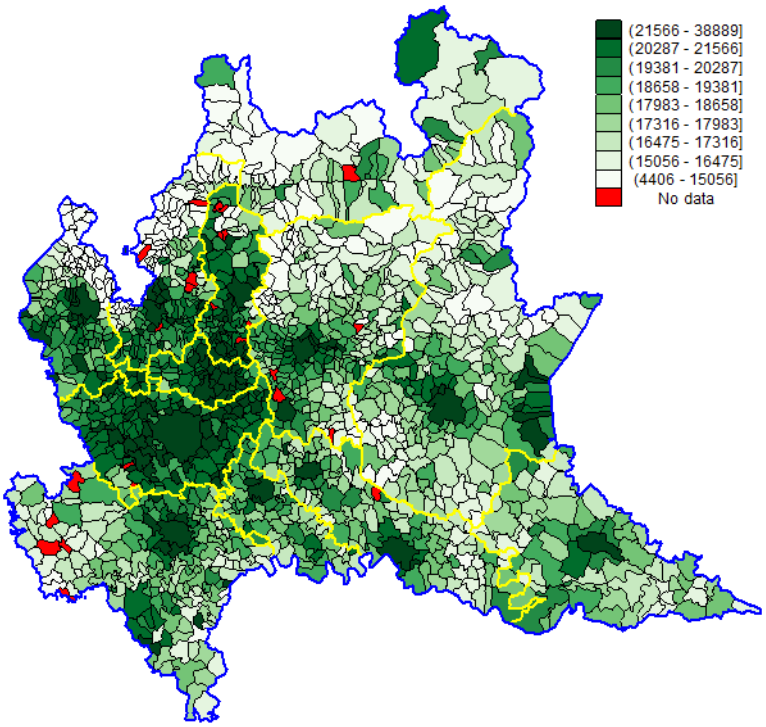


Figure 2.6 - Delta in median incomes: Italians vs Immigrants (reverse scale), 2012

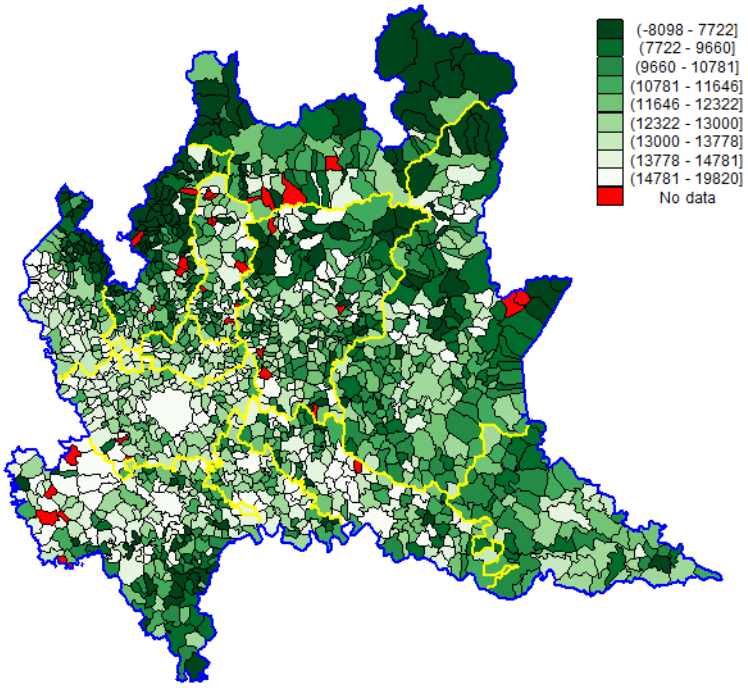
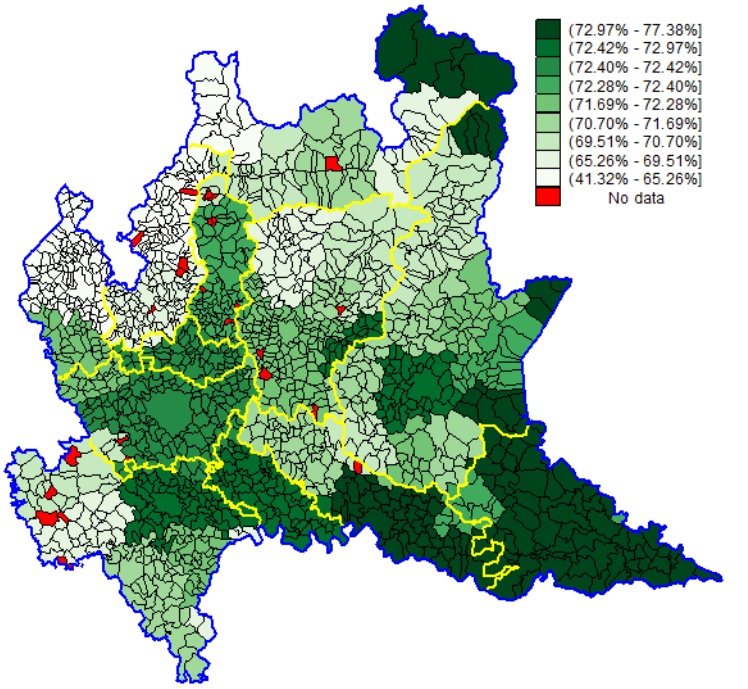


Figure 2.7 - Employment rate of the Italians by labour local system, 2012



2.6 Transmission channels and empirical model

As discussed on Section 2.3 (theory channels), we argue that immigration might affect electoral outcomes trough three main channels: (1) "ideological" anti-immigration (IIC); (2) crowding-out effect ($COEC$); (3) labor-market competition (LMC). The relationship between votes to anti-immigrant parties and the three channels above can be summarized by the following general equation:

$$Share\ of\ votes = f(ideology, crowding\ out, labor\ market, controls)$$

As previously pointed out, a high share of immigrants not necessarily implies all the effects. In order to investigate the effect of these channels we have first to define them properly and design a strategy to distinguish and measure them.

2.6.1 The "ideological" immigration channel

2.6.1.1 The basic setup

The ideological immigration channel will be indicated with the acronym IIC, to which we will add a time suffix to specify what is the one at hand, in case the channel is measured through more than one indicator. The standard literature on the electoral effects of immigration focuses on the following basic model, simply based on the "ideological" effect of immigration:

$$Share\ of\ votes = \alpha + \beta \cdot share\ of\ immigrants + X'\gamma + \varepsilon$$

where X' is a set of socio-political controls. We start by fitting the previous regression but using the variation in the share of votes for the Northern League from the last elections and the previous ones. The resulting specification is as follws:

$$\Delta NL^{H}_{m,2013-2008} = \alpha + \beta^{H}_{1} IIC_{m,2012} + X^{'}_{m,2012}\vartheta^{H} + \varepsilon^{H}_{m,2012} \qquad (1)$$

where $\Delta NL^{H}_{m,2013-2008}$ denotes the change of vote shares of the NL between the elections in 2013 and 2008 at the House election and m denotes the municipality. $IIC_{m,2012}$ is the main explanatory variable, i.e. the share of immigrants over the total population in 2012 in municipality m. $X'_{m,2012}$ is a set of socio-political municipal controls, i.e., the size of the city (below vs above fifteen thousand inhabitants), the share of females and the percentage

of each age class in municipality m in 2012. The sign of β_1^H is not clear a priori: the comparison between Figure 2.2 and Figure 2.3 should suggest a negative one, but the conflicting results found in the literature do not allow us to predict it.

First, we recognize that the effect of immigration on voting outcomes might be non-linear in the share of immigrants according to the second aspect of contact theory[14]. To address this we added the square of the share of immigrants in 2012 to the model:

$$\Delta NL^H_{m,2013-2008} = \alpha + \beta_1^H IIC_{m,2012} + \beta_2^H \left(IIC_{m,2012}\right)^2 + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \qquad (2)$$

Moreover, more recent research (Levi et al., 2017) has pointed out how the support for right-wing parties resulting from an increased immigrant presence is only temporary. The inflow of new immigrants matters the most, since - over time - its effect on voting behavior progressively vanishes. This is in line with the predictions of one aspect of contact theory. To account for this process, we add to the share of immigrants in 2012 its growth rate between 2007 and 2012 ($IIC_{2012-2007}$) and estimate the following equation:

$$\Delta NL^H_{m,2013-2008} = \alpha + \beta_1^H IIC_{m,2012} + \beta_2^H IIC_{m,2012-2007} + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \qquad (3)$$

If recent inflows are driving the support for the Northern League, we expect the sign of β_2^H to be positive and significant.

Finally, we combine the two aspects of the contact theory and allow both for a short run effect and for non-linearities in the share of immigrants:

$$\Delta NL^H_{m,2013-2008} = \alpha + \beta_1^H IIC_{m,2012} + \beta_2^H IIC_{m,2012-2007} +$$

$$+ \beta_3^H \left(IIC_{m,2012}\right)^2 + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \qquad (4)$$

Here, we allow the effect of immigration to be both increasing for municipalities with a low share of immigrants and decreasing for municipalities with a higher one. If this is the case, we expect the sign of β_3^H to be negative and significant.

Combining these aspects, we can then define the "ideological immigration channel":

$$IIC'_m\beta^H = \beta_1^H IIC_{m,2012} + \beta_2^H IIC_{m,2012-2007} + \beta_3^H \left(IIC_{m,2012}\right)^2 \qquad (5)$$

2.6.1.2 Endogeneity

It is important to highlight that there is a potential endogeneity issue associated to the share of immigrants: the immigrants' location decisions are not random, because they clearly

[14] Cfr. Section 3.3 for further details.

depend – through a network effect – on the past distribution of immigrants; moreover, the political orientation of the voters towards the Northern League might have affected the location decisions of the immigrants. To deal with this endogeneity issue we instrument the share of immigrants both in 2007 and in 2012 and we take their difference to get the instrument for the growth rate of immigrants over that five years period.

To predict these shares we use a shift-share procedure[15] based on the distribution of immigrants by nationality and municipality in 1991 and 2003, respectively. The choice of 1991 as base year is particularly handy, because none of the current parties had already taken part in a national election back then and the pre-existing parties had no clear stance on immigration issues, because the immigrants' presence was negligible. Besides the 1991 data, the oldest available data about immigrants by nationality are from 2003. To compute the instrument, we implement the following formula[16]:

$$\frac{\sum_{c=1}^{N} \gamma_{mc} Immigrants_{ct,-m}}{Population_{mt}}$$

Where γ_{mc} is the immigrants' share originating from country c and residing in municipality m, in 1991 (2003). $Immigrants_{ct,-m}$ is the region-level number of immigrants coming from country c, in year 2007 (2012), net of the participation of municipality m to the total. $Population_{mt}$ is the overall population in municipality m and in year t. Finally, N is the number of top foreign nationalities in Lombardy in 2007 and 2012[17].

2.6.2 The "rational economic channels"

If the votes for the Northern league are not purely anti-immigration per se, the economic differences between the Italians and the immigrants might play a role and two "economic" channels could come into play. The economic heterogeneity (or homogeneity) of the immigrants with respect to the Italians can have different outcomes. If immigrants are very different from the Italians, there might show up a "crowding-out effect". On the contrary, if immigrants are very similar to the Italians, there might be an increase in the competition

[15] We follow the procedure suggested by Cortes and Pan (2015), as previously done by Barone et al. (2014).
[16] This formula has been already used by Barone et al. (2014).
[17] N has been set equal to 15 and we selected these 15 top nationalities: Romania, Morocco, Albania, Egypt, China, Philippines, India, Peru, Ecuador, Pakistan, Senegal, Sri-Lanka, Tunisia, Ghana, Brazil.

on the labor market and voters could vote against the immigrants because they believe that "immigrants steal their jobs".

2.6.2.1 Crowding-out effect channel

To capture how economically different the Italians are from the immigrants – after controlling for the average income of the Italians – we computed the difference between the median incomes of the Italians relative to the median incomes of the immigrants[18]. The model we estimated is the following:

$$\Delta NL^{H}_{m,2013-2008} = \alpha + IIC'_m\beta^H + \gamma_0^H avgInc^{ITA}_{m,2012} + \gamma_1^H COEC^{ITA-IMM}_{m,2012} + \\ + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \quad (6)$$

where $avgInc^{ITA}_{m,2012}$ stands for the average income of the voters in 2012 in municipality m, i.e. the level of economic development of the municipality, and $COEC^{ITA-IMM}_{m,2012}$ is the difference in median incomes between the Italians and the immigrants in 2012 in municipality m. We use the average level of income because we consider it as a proxy for the welfare of the municipality, given the progressivity of the fiscal system. On the other hand, we use the difference in median incomes because it captures better the actual relative position of the immigrants relative to the income of the median Italian[19]. γ_1^H is our coefficient of main interest: if it is positive and significant we can argue that the crowding-out effect plays a role, increasing the support for the NL if the immigrants are poor relative to the voters. Vice-versa, if γ_1^H is negative or not significant we can conclude that the crowding-out effect is not a determinant of the electoral success of the Northern League.
We also want to control for the different effect that the heterogeneity between Italians and immigrants might have depending on the share of immigrants living in municipality m. To account for that we add an interaction term between the difference in median incomes and the change in the share of immigrants in 2012. We then estimate the following model:

$$\Delta NL^{H}_{m,2013-2008} = \alpha + IIC'_m\beta^H + \gamma_0^H avgInc^{ITA}_{m,2012} + \gamma_1^H COEC^{ITA-IMM}_{m,2012} + \\ + \gamma_2^H \left(COEC^{ITA-IMM}_{m,2012} \times IIC'_m\right) + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \quad (7)$$

[18] It is worth noting that labor-market competition does not necessarily arise because of immigration inflows; it crucially depends on the abilities of the immigrants relative to the natives. If they are looking for jobs in sectors that are different from the Italians' preferred ones, the labor markets could not overlap and there might be no variation in the labor market competition.
[19] It is worth noting that the electoral pool contains only Italians, because the right to vote depends on the citizenship. Hence, the median adult Italian coincides with the median voter.

If the crowding out effect matters – i.e. γ_1^H is positive and significant – and it has a different impact on the support for the NL depending on the share of resident immigrants, we expect γ_2^H to be positive and significant. On the other hand, if γ_2^H is not significant it implies that the share of immigrants does not affect the impact of the difference in median incomes on the support for the NL. Finally, if γ_2^H is negative and significant, it suggests that an increase in the share of immigrants does not matter when the immigrants are different from the voters. Specifically, if Italians are significantly richer than the immigrants, they might be already crowded-out.

We then define the "crowding-out effect channel" as follows:

$$COEC'_m\gamma^H = \gamma_0^H avgInc_{m,2012}^{ITA} + \gamma_1^H COEC_{m,2012}^{ITA-IMM} + \gamma_2^H\left(COEC_{m,2012}^{ITA-IMM} \times IIC'_m\right) \quad (8)$$

and conclude that the importance of the crowding out channel depends on the positivity and significance of the γ_1^H and γ_2^H coefficients.

2.6.2.2 Labor market competition channel

Isolating the labor market competition channel (LMC) is not straightforward. Firstly, we have to control for the employment level of the Italians, to take into account the local employment status. In fact, areas with higher employment rate could simply express a different support for the NL depending on the party's economic agenda. This can be accomplished in two ways:

- computing the employment rate of the Italians at the local labor system level
- using local labor system fixed effects and then controlling for the employment rate of the Italians at the municipal level

Once we have controlled for the local labor market status, we have to investigate how immigration – conditional on employment – affects the support for the Northern League. To do that, we interact the employment rate of the Italians with the change in the share of immigrants between 2007 and 2012 at the municipal level. The resulting model that we estimate is:

$$\Delta NL_{m,2013-2008}^H = \alpha + IIC'_m\beta^H + COEC'_m\gamma^H + \delta_0^H LMC_{LLS,2012}^{ITA} +$$

$$+ \delta_1^H\left(LMC_{LLS,2012}^{ITA} \times IIC'_m\right) + X'_{m,2012}\vartheta^H + \varepsilon_{m,2012}^H \quad (9)$$

where we control for the employment rate of the Italians at the LLS in 2012 (coefficient δ_0^H) and we do not use LLS fixed effects. Vice versa, if we use LLS-effects, we obtain the following model:

$$\Delta NL^H_{m,2013-2008} = \alpha + IIC'_m\beta^H + COEC'_m\gamma^H + \delta_0^H LMC^{ITA}_{m,2012} +$$

$$+ \delta_1^H(LMC^{ITA}_m \times IIC'_m) + X'_{m,2012}\vartheta^H + \alpha_{LLS} + \varepsilon^H_{m,2012} \quad (10)$$

where we control for the employment rate of the voters at the municipal level in 2012 (coefficient δ_0^H) and use local labor system fixed effects (α_{LLS}).

In both specifications the coefficient of main interest is δ_1^H, which captures the effect of the interaction of the change in the share of immigrants between 2007 and 2012 with the employment rate of the Italians at the LLS or municipal level respectively. We expect δ_1^H to be positive and significant if the labor-market competition channel actually matters. Instead, if δ_1^H is not significant, it means that the presence of immigrants does not affect the support for the NL through the labor-market. An extreme case would be the one in which δ_1^H is negative and significant. It would be possible in a situation in which the employment rate of the Italians is very high and there would be complementarity between the skill set of the Italians and the immigrants.

We then define the "labor market competition channel" as:

$$LMC'_{LLS,m}\delta^H = \delta_0^H LMC^{ITA}_{LLS,2012} + \delta_1^H\left(LMC^{ITA}_{LLS,2012} \times IIC'_m\right) \quad (11)$$

when not using LLS fixed effects. Vice versa, with LLS fixed effects, it becomes:

$$LMC'_m\delta^H = \delta_0^H LMC^{ITA}_{m,2012} + \delta_1^H\left(LMC^{ITA}_{m,2012} \times IIC'_m\right) \quad (12)$$

We can finally sum up our model with the following equation:

$$\Delta NL^H_{m,2013-2008} = \alpha + (\alpha_{LLS} +)IIC'_m\beta^H + COEC'_m\gamma^H +$$

$$+ LMC'_{(LLS,)m}\delta^H + X'_{m,2012}\vartheta^H + \varepsilon^H_{m,2012} \quad (13)$$

It is now important to highlight what are the reasons to consider the inclusion of LLS fixed effect in our model:

- Even if the administrative unit above municipalities is the province, provinces just define administrative areas and have little to do with economic and labor system areas;

- The local labor systems are very often cross-provinces;
- The LLS', by definition, have much more homogeneous labor markets than the provinces, hence, if we still find an effect of immigration on the support for the NL through the municipal employment rate of the Italians, this effect is much cleaner.

Adding the LLS fixed effects – of course – comes at a cost:

- The loss of many degrees of freedom, because there are 57 additional parameters to estimate
- The loss of a lot of cross-section variability in the share of the immigrants among LLS, which causes the significance of the main effect of immigration on the support for the NL to fade away.

2.6.3 Exploiting elections contemporaneity to isolate the rational economic channels

Previously, we have distinguished the transmission channels through which immigration fosters the support for the NL in "ideological" and "rational economic". Moreover, in section 2.4 we pointed out that the national and regional elections where unusually contemporaneous in 2013 and that the national and regional governments have different competences with respect to immigration management. Hence, if the votes for the Northern League are purely anti-immigrants and the rational economic channels do not play any role in explaining voters' behavior, the electoral outcomes should be the same at the national and regional elections. This is not the case, as clearly reported in Table 2.1. The vote share of the NL is – on average – higher at the national level and, even if the minimum and maximum share of votes are quite similar at the national and regional level, when we take the difference between the two outcomes it is easy to see that they can differ by up to 20%. These differences lead us to wonder whether by taking the difference between the two electoral outcomes we can shed light on how the rational channels affect the NL support across different levels of government.

We state and discuss a set of assumptions that are needed to be able to claim that the difference between the two elections is driven only by the rational channels:

- Same timing, i.e. the elections are contemporaneous;

Table 2.1 - Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Electoral outcomes					
NL vote shares - House	1517	16.8%	6.7%	2.9%	49.2%
NL vote shares - Region	1517	15.8%	6.8%	0.0%	52.1%
Δ NL votes: House 2008-2013	1492	-10%	4%	-28%	10%
Δ NL votes: House vs Region	1517	1.0%	3.6%	-16.8%	21.3%
Immigration indexes - "ideological" component					
Share of immigrants	1542	8.9%	4.7%	0.0%	30.4%
Share of immigrants in 2007	1485	6.8%	3.8%	0.0%	23.0%
Share of immigrants growth 2007-12	1472	2.1%	1.8%	-5.8%	14.0%
Instrument for 2012	1524	7.1%	5.5%	0.0%	41.8%
Instrument for 2007	1541	3.8%	4.5%	0.0%	61.6%
Economic explanatory variables "rational" component					
Italians avg income	1542	18'331	3'050	4'406	38'889
Δ median income Ita-Imm	1535	11'358	3'510	-8'098	19'820
Employment rate by LLS	1542	67.4%	5.8%	39.4%	72.9%
Municipal Italians empl. Rate	1542	67.1%	7.5%	12.2%	80.7%
Controls					
Firms per capita by municipality	1541	0.08	0.101	0.0	3.40
Municipal population	1541	6'543	36'060	33	1'357'310
Towns above 15k inhabitants	1542	Below: 1434 (93%)		Above: 108 (7%)	
Share of females	1541	50.2%	1.4%	40.0%	56.2%
Population aged 0-14	1541	14.1%	2.5%	1.9%	22.0%
Population aged 15-34	1541	20.6%	2.3%	8.0%	30.4%
Population aged 35-64	1541	44.9%	2.0%	33.9%	56.0%
Population aged 65-plus	1541	20.4%	4.7%	5.5%	51.2%
Share of college graduate	1542	9.2%	3.6%	0.0%	35.5%

- Voters are fully informed: this assumption is useful, but it is not strictly necessary, because we are not claiming to fully identify the magnitude of the rational channel, we are just arguing that the difference in elections' outcome is driven by the most informed voters – which understand that the two level of governments have different competences with respect to immigration. Hence, we slightly relax this assumption by assuming that the voters who cast different votes for the two levels of government are fully informed;
- The electoral systems are the same across levels of government: they are indeed extremely similar, the only two difference being the possibility to express a disjoint vote and preferences at the regional elections[20]
- Italians vote for the party and not for the people in the list: it is not possible to vote for a party and express preferences for candidates listed in a different one, hence, firstly, people have to decide which party to support. Moreover, it is hard to argue that the candidate to the regional elections was significantly different from the national party, because in 2013 Maroni was both the national secretary of the NL and the NL candidate as regional governor. His stances about immigration have also been made very clear by his service as an Interior minister between 2008 and 2011. As a result, the party line is expected to be the same at both elections.

We compare the House elections with the regional ones, because for the Senate elections the electoral pool is smaller, being required to be above 25 years old to vote for the senators election. Taking the difference between the NL share of votes at the House and regional elections, we estimate the following model:

$$\Delta NL^{HR}_{m,2013} = \alpha + (\alpha_{LLS} +) IIC'_m \beta^{HR} + COEC'_m \gamma^{HR} +$$

$$+ LMC'_{(LLS,)m} \delta^{HR} + X'_{m,2012} \vartheta^{HR} + \varepsilon^{HR}_{m,2012} \quad (14)$$

If the "ideological" transmission channel does not vary across elections' level, we expect β^{HR} to be not statistically significant. To check this we perform a joint F-test on the coefficients associated to the IIC channel. If we cannot reject the null hypothesis of joint non-significance we can conclude that the ideological component does not vary across the

[20] Both at the national and regional level, the electoral system is a proportional one, with a majority premium awarded to the winning candidate. The only differences between the two systems regard the disjoint vote and preferences. Specifically, at the regional elections, a voter can vote for a party but vote for a different governor candidate. Moreover, she can express up to two (if of different gender) preferences for the candidates to the regional assembly. However, the preferences have to be expressed for the supported party.

different levels of election. On the other hand, if γ^{HR} or δ^{HR} are significant, it means that the economic explanatory variables can explain the non-ideological component of the votes gained by the NL. The interpretation of their sign is the same suggested for the previous specifications. We also control for the usual set of socio-economic features appearing in $X'_{m,2012}$. Finally, we perform the usual robustness check with LLS fixed effects and IV estimates on the full model.

2.7 Main econometric results

2.7.1 Baseline results

Table 2.2 (i.e. equations 1 – 4) displays the baseline results regarding (only) the IIC. The odd numbered columns show row estimates controlling only for size of municipalities, while the even numbered columns include municipal level socio-economic controls.

First of all, it is important to bear in mind that the previous literature analyze situations in which the anti-immigrants parties were significantly increasing their share of votes. In our framework, however, the share of votes of Northern League was – on average – decreasing between 2008 and 2013, due to two main reasons: (1) the Northern League has generally gathered a strong support in Lombardy, so their starting point was generally high; (2) the electoral cycle was not favorable to the center-right coalition, to which the NL belongs. Hence, we expect some of our controls to behave differently from the previously analyzed contexts, given that we are focusing on small and not-necessarily positive variations in the share of votes.

The first two columns show the results for the main effect of the stock of immigrants (eq. 1), columns (3) and (4) account for the possible non-linear effect of immigration on voters' behavior (eq. 2), columns (5) and (6) account for short vs long-run effects (eq. 3) and the last two columns allow for both (eq. 4). We find that the stock of immigrants has a positive and statistically significant effect, which is however non-linear, as the coefficient associated to its square is negative and strongly significant. The last four columns seem to suggest that there is no significant short-run effect of new immigrants' inflow. In the evenly numbered columns, we also control for a set of municipal characteristics, such as the share of females,

Table 2.2 - Effect of immigration on the variation of the share of votes for the Northern League at the House's elections between 2008 and 2013

VARIABLES	Dependent variable: Delta NL share of votes 2013-2008, House elections							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of immigrants	0.116**	0.233***	0.311***	0.446***	0.119**	0.236***	0.394***	0.475***
	(0.0450)	(0.0469)	(0.112)	(0.107)	(0.0479)	(0.0504)	(0.119)	(0.110)
Share of immigrants squared in 2012			-0.913**	-1.010**			-1.280***	-1.130***
			(0.400)	(0.390)			(0.431)	(0.387)
Immigration growth rate over 5 years					-0.000141	-0.00219	-0.000297	-0.00225
					(0.00301)	(0.00291)	(0.00291)	(0.00288)
Town with Pop>15k	0.0117**	0.00919*	0.0111**	0.00961**	0.0141**	0.0114*	0.0136*	0.0121*
	(0.00488)	(0.00471)	(0.00484)	(0.00462)	(0.00692)	(0.00653)	(0.00694)	(0.00658)
Share of females		0.121		0.0760		0.120		0.0722
		(0.111)		(0.115)		(0.123)		(0.126)
Population aged 0-14		-0.496***		-0.489***		-0.534***		-0.526***
		(0.127)		(0.126)		(0.131)		(0.132)
Population aged 15-34		-0.517***		-0.505***		-0.527***		-0.511***
		(0.160)		(0.160)		(0.158)		(0.157)
Population aged 65-plus		-0.242**		-0.227**		-0.263**		-0.249**
		(0.113)		(0.111)		(0.114)		(0.113)
Share of college graduate		0.00755		-0.00648		0.00196		-0.0120
		(0.0338)		(0.0330)		(0.0365)		(0.0361)
Firms per capita		-0.0104		-0.0104		-0.0126		-0.0125
		(0.00858)		(0.00822)		(0.0104)		(0.00992)
Constant	-0.109***	0.0460	-0.117***	0.0548	-0.109***	0.0592	-0.121***	0.0676
	(0.00514)	(0.0734)	(0.00659)	(0.0752)	(0.00548)	(0.0821)	(0.00724)	(0.0844)
Observations	1,492	1,491	1,492	1,491	1,424	1,424	1,424	1,424
R-squared	0.028	0.110	0.034	0.117	0.031	0.117	0.043	0.125

Clustered (at the LLS level) standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

the population structure by age, the share of college graduate, number of firms per capita and a dummy for towns with more than 15k inhabitants. The share of female is not significant in any specification, suggesting that there is no gender specificity at work here. The same goes for the share of college graduate and the number of firms per capita. The youngest and the oldest seem to have a lower preference for the Northern League, relative to our reference category, which are voters aged 35-64 years old. It is important to underline how, in contrast with the previous literature – especially with respect to Barone et al. (2014) and Dustmann et al. (2016) – we find a positive and significant effect for big municipalities, meaning that the Northern League – while still receiving less support than in the countryside – relatively gained support in bigger municipalities with respect to small ones. The municipal population size, however, has a non-linear effect. If we control, as a robustness check, for the square of age it turns out that the associated coefficient is negative, again suggesting that bigger municipalities still react differently[21].

2.7.2 Introducing the "rational" economic channels

We now introduce in turn the "rational" channels, analyzing more extensively the results shown in Table 2.2. In Table 2.3, we add the COE and LM channels to the specification of column (4) of Table 2.2. All columns include socio-economic controls and column (4) includes LLS fixed effects too. Column (1) controls for the average income of the Italians and the difference in median incomes between Italians and immigrants. The former shows a negative effect, suggesting that richer municipalities exhibit a lower support for the NL. The latter has a positive effect, suggesting that the larger the difference in incomes between Italians and immigrants, the bigger the support for the NL.

Column (2) adds the interaction between the share of immigrants and the difference in median incomes. As expected the average income of the Italians has a negative effect on the variation in the votes for the NL and the delta in median incomes has a positive one, even if not significant. However, when we add the LM channel at the LLS level (column 3), also the interaction between the share of immigrants and the difference in median incomes becomes strongly significant. This suggests that, on the one hand, richer areas show a lower support for the NL, but, on the other hand, this support increases the more the immigrants are poor relative to the voters. The positivity of the coefficient associated to the interaction between

[21] Estimates for non-linearities in population are available upon request.

Table 2.3 - Effect of immigration on the variation of the share of votes for the Northern League at the House's elections between 2008 and 2013 - Squared specification

VARIABLES	Dependent variable: Delta NL share of votes 2013-2008, House elections			
	(1)	(2)	(3)	(4)
Share of immigrants	0.503***	1.172**	0.580	0.334
	(0.110)	(0.541)	(0.626)	(0.579)
Share of immigrants squared in 2012	-1.265***	-1.219***	-1.383***	0.0325
	(0.399)	(0.404)	(0.412)	(0.302)
Ln Italians avg income	-0.0299**	-0.0304**	-0.0378**	0.0141
	(0.0133)	(0.0136)	(0.0175)	(0.0175)
Ln Δ median income Ita-Imm	0.00649*	0.0113*	0.0159***	0.0115
	(0.00371)	(0.00599)	(0.00571)	(0.00703)
Ln(Δ med income Ita-Imm) × Imm share		-0.0734	-0.156**	-0.0805
		(0.0610)	(0.0639)	(0.0790)
Italians empl. rate by LLS			-0.119	
			(0.0865)	
Employment rate blls × Imm share			2.042**	
			(0.905)	
Municipal Italians empl. rate				-0.172***
				(0.0531)
Employment rate bm × Imm share				0.667
				(0.467)
Town with Pop>15k	0.0107**	0.0112**	0.0101**	0.00572**
	(0.00454)	(0.00445)	(0.00432)	(0.00231)
Constant	0.314**	0.274*	0.391**	-0.191
	(0.139)	(0.152)	(0.156)	(0.171)
Socio-economical controls	YES	YES	YES	YES
Local labor system fixed effects	NO	NO	NO	YES
Observations	1,466	1,466	1,466	1,466
R-squared	0.136	0.138	0.148	0.060
Number of LLS				57

Clustered (at the LLS level) s.e. in parentheses: *** p<0.01, ** p<0.05, * p<0.1

the delta in median incomes and the share of immigrants – despite being counter-intuitive – is consistent with the crowding-out theory. In fact, an increase in the share of immigrants, when the median incomes between the two groups are very different, loosens – or might even eliminate – the competition between immigrants and Italians about social services. These results seem to confirm the importance of the crowding-out effect channel in shaping voters behavior.

As for the LM channel, on the one hand, the employment rate of the Italians has a negative effect, but it is not significant. On the other hand, the interaction between the employment rate and the share of immigrants has a positive and significant effect, suggesting that – holding constant the employment rate of the voters – the presence of immigrants fosters the support for the NL. It is also worth highlighting that the main effect of immigrants looses significance in this specification. The square of the stock of immigrants remains negative and strongly significant across columns (1) to (3).

Lastly, column (4) introduces LLS fixed effects and accounts for the LM channel at the municipal level. The IIC and COEC show no significance in this specification. The employment rate of the Italians at the municipal level exhibits a negative and significant effect, while the corresponding interaction term is positive, but not significant.

At least qualitatively, the results for the LMC hold their relevance across columns (3) and (4): the employment rate of the voters has a negative effect on the NL performance, even when accounting for LLS fixed effects; its interaction with the share of immigrants, on the other hand, increases the support for the NL. These results are in line with our prior that holding constant the employment rate, an increase in the share of immigrants – augmenting the labor market competition – fosters the performance of the NL. In conclusion, when we properly control for labor market specificities, the labor market channel is the one that matters the most.

Table 2.4 explores the full model, i.e. deepens the analyses of the last two columns of Table 2.2 and aims to check whether the results of Table 2.3 are robust to the introduction of the short-term effect of new inflows. The growth rate of immigrants is not significant across the specifications of columns (1) to (3). The same is true for the corresponding interactions terms, except for column (2), where we interact the growth share of immigrants with the employment rate of the Italians at the LLS level. Here, it exhibits a positive and significant effect, suggesting that new inflows are associated with a perceived higher competition on the labor market, increasing the support for the NL.

Table 2.4 - Effect of immigration on the variation of the share of votes for the Northern League at the House's elections between 2008 and 2013 - Full IIC specification

VARIABLES	Dependent variable: Delta NL share of votes 2013-2008, House elections		
	(1)	(2)	(3)
Share of immigrants	1.507***	0.786	0.841
	(0.541)	(0.712)	(0.577)
Immigration growth rate over 5 years	0.0486	0.00112	0.0233
	(0.0476)	(0.0522)	(0.0512)
Share of immigrants squared in 2012	-1.228***	-1.397***	0.0278
	(0.412)	(0.423)	(0.316)
Ln Italians avg income	-0.0313**	-0.0377**	0.0127
	(0.0130)	(0.0167)	(0.0184)
Ln Δ median income Ita-Imm	0.0169**	0.0223***	0.0196***
	(0.00633)	(0.00544)	(0.00608)
Ln(Δ med income Ita-Imm) × Imm share	-0.109*	-0.183***	-0.140*
	(0.0609)	(0.0614)	(0.0742)
Ln(Δ med income Ita-Imm) × Imm gr 5 years	-0.00557	-0.00858	-0.00504
	(0.00501)	(0.00675)	(0.00651)
Italians empl. rate by LLS		-0.173*	
		(0.0878)	
Employment rate blls × Imm share		2.114**	
		(0.988)	
Employment rate blls × Imm gr 5 years		0.114**	
		(0.0461)	
Municipal Italians empl. rate			-0.196***
			(0.0593)
Employment rate bm × Imm share			0.723
			(0.503)
Employment rate bm × Imm gr 5 years			0.0326
			(0.0487)
Town with Pop>15k	0.0142**	0.0128**	0.00729**
	(0.00657)	(0.00636)	(0.00321)
Constant	0.237	0.379**	-0.240
	(0.155)	(0.170)	(0.179)
Socio-economical controls	YES	YES	YES
Local labor system fixed effects (57)	NO	NO	YES
Observations	1,408	1,408	1,408
R-squared	0.141	0.157	0.064
F-test on COEC: Prob>F	0.0172	0.0006	0.0075
F-test on LMC: Prob>F	/	0.0241	0.0094

Clustered (at the LLS level) standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

What is important to emphasize is that the coefficients associated to the COEC are jointly significant at the 1% level across columns (1) to (3). Moreover, the coefficients associated to the LMC are significant to the 5% level for column (2) and at the 1% level for column (3). Having stated that COEC and LMC are relevant to voters' behavior it is interesting to evaluate which of the two channels has the larger impact. The net[22] effect of LMC is larger than COEC's one, the former accounting for 5.25% of the NL share of votes and the latter for 4.65%.

Finally, what is the effect of an increase in the share of immigrants on the support for the NL? Our model predicts that a 2.1% increase of the share of immigrants – above the average – in the last 5 years prior to the elections is associated to a 2.25% increase in the NL share of votes.

Table 2.5 shows IV estimates of columns (1) to (4) of Table 2.2 specifications, with the first two columns referring to eq. 1 and the last two columns referring to eq. 2. Odd numbered columns only include a dummy for towns with more than 15 thousand inhabitants, while even numbered ones include also the other usual municipal controls. Here, we instrumented the share of immigrants and its square with a Card-instrument with 2003 as base-year and its square, respectively. The implied effect of a 2.1% increase of the share of immigrants is a 1.04% increase in the support for the NL.

Lastly, we also produced IV estimates for Table 2.4. Here, having three – the stock of immigrants in 2012, its square and its variation between 2007 and 2012 – potentially endogenous variables, we use three different instrument: the estimated share of immigrants in 2012 based on immigrants' distribution in 2003, its square and its difference with respect to estimated share of immigrants in 2007 based on immigrants' distribution in 1991. Unfortunately, our estimates on the full model loose significance (see Table B.1). However, it has to be noted that if we estimate the baseline specification including only the IIC without the growth rate immigrants and controlling for the socio-economic variables at the municipal level, even the IV estimated remain significant (see Table 2.5) . The loss of significance of the full model is likely to depend on the high number of variables that had to be instrumented (up to 7 in the full specifications), due to the interaction terms relative to the COE and LMC channels.

[22] By net COEC and net LMC, we mean net of the effect of the average income and employment rate of the Italians, respectively.

Tabella 2.5 - Effect of immigration on the variation of the share of votes for the Northern League at the House's elections between 2008 and 2013 - IV estimates

VARIABLES	Dependent variable: Difference in the NL share of votes 2013-2008			
	(1)	(2)	(3)	(4)
Share of immigrants in 2012	0.143**	0.256***	0.423*	0.674***
	(0.0577)	(0.0554)	(0.243)	(0.228)
Share of immigrants squared in 2012			-1.296	-1.987**
			(1.041)	(0.995)
Town with Pop>15k	0.0111**	0.00965**	0.0103**	0.0104**
	(0.00518)	(0.00465)	(0.00515)	(0.00448)
Share of females		0.0689		-0.0193
		(0.103)		(0.118)
Population aged 0-14		-0.506***		-0.487***
		(0.124)		(0.127)
Population aged 15-34		-0.605***		-0.577***
		(0.151)		(0.151)
Population aged 65-plus		-0.268**		-0.242**
		(0.105)		(0.105)
Share of college graduate		-0.00232		-0.0257
		(0.0333)		(0.0375)
Firms per capita		-0.0141		-0.0140
		(0.0109)		(0.00995)
Constant	-0.111***	0.0964	-0.123***	0.112
	(0.00656)	(0.0662)	(0.0115)	(0.0700)
Observations	1,474	1,473	1,474	1,473
R-squared	0.030	0.122	0.039	0.126

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Variables in italics are instrumented with a Card-instrument with base-year 2003 and its square, respectively.

2.7.3 Trying to isolate the "rational" economic channels

Table 2.6 reproduces Table 2.4, using as a dependent variable the difference between the NL's electoral performance at the House relative to the Regional level, following specification (14). As usual, the even columns include socio-economic controls, while the odd ones do not.

The results from the first two columns suggest that only the stock of immigrants is mildly significant in this context. However, the F-test of joint significance fails to reject the null hypothesis of joint non-significance for the IIC. The same is true for COE channel.

Table 2.6 - Effect of the COEC and LMC on the difference of the share of votes for the Northern League between the House and Regional elections in 2013

VARIABLES	Dependent variable: Delta NL share of votes House vs Regional elections, 2013			
	(1)	(2)	(3)	(4)
Share of immigrants	1.575**	1.528*	0.800	0.842
	(0.781)	(0.765)	(0.568)	(0.584)
Immigration growth rate over 5 years	0.0247	0.0278	0.0233	0.0296
	(0.0450)	(0.0435)	(0.0445)	(0.0420)
Share of immigrants squared in 2012	0.618	0.581	0.639**	0.586**
	(0.597)	(0.582)	(0.266)	(0.257)
Ln Italians avg income	-0.0331**	-0.0300*	-0.0415***	-0.0353**
	(0.0133)	(0.0177)	(0.0134)	(0.0171)
Ln Δ median income Ita-Imm	0.01000	0.00929	0.0131	0.0125
	(0.00958)	(0.0101)	(0.00837)	(0.00856)
Ln(Δ med income Ita-Imm) × Imm share	-0.0122	-0.00539	-0.0696	-0.0692
	(0.0829)	(0.0863)	(0.0748)	(0.0761)
Ln(Δ med income Ita-Imm) × Imm gr 5 years	-0.00753	-0.00768	-0.00387	-0.00442
	(0.00726)	(0.00698)	(0.00586)	(0.00563)
Italians empl. rate by LLS	0.170	0.164		
	(0.114)	(0.108)		
Employment rate blls × Imm share	-2.366**	-2.383**		
	(1.177)	(1.135)		
Employment rate blls × Imm gr 5 years	0.0523	0.0505		
	(0.0429)	(0.0440)		
Municipal Italians empl. rate			0.0263	0.0215
			(0.0497)	(0.0495)
Employment rate bm × Imm share			-0.510	-0.522
			(0.322)	(0.333)
Employment rate bm × Imm gr 5 years			0.0180	0.0162
			(0.0332)	(0.0327)
Town with Pop>15k	0.00134	0.00371*	0.00144	0.00241
	(0.00207)	(0.00216)	(0.00164)	(0.00167)
Constant	0.138	0.155	0.288*	0.299
	(0.125)	(0.171)	(0.148)	(0.196)
Socio-economical controls	NO	YES	NO	YES
Local labor system fixed effects (57)	NO	NO	YES	YES
Observations	1,432	1,432	1,432	1,432
R-squared	0.053	0.062	0.055	0.071
F-test on IIC: Prob>F	0.155	0.1586	0.0924	0.0988

Notes: Clustered (at the LLS level) standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Despite the non-significance of the employment rate of the Italians, the LMC is jointly significant nearly[23] at the 5% level, thanks to the strong significance of the interaction between the employment rate and the share of immigrants.

If we compare these results with the ones from Table 2.4, though, it is clear that the coefficients associated to the LMC channel have an opposite sign. This means that – contrary to what we expected – the LMC is stronger for the regional elections and voters trust more in the regional government when asking for protection on the labor market.

Columns (3) and (4) account for LLS fixed effects, thus, the employment rate and its interactions are computed at the municipal level. In this context we just[24] reject the null hypothesis of non-significance of the IIC at the 10% level, due to the significance of the square of the stock of immigrants. The joint F-test is not significant for the COE and LMC, even if the average income of the Italians has a negative and strongly significant effect on the votes for the NL. As stated in section 2.6.2.2, the estimation with LLS fixed effects is very demanding, both in terms of residual variability of the dependent variable and loss of degrees of freedom (there are 57 LLS). This also suggests that – when accounting for specificities in the local labor systems – the effect of immigration becomes less relevant.

When we run IV estimates for the specifications of Table 2.6, we completely loose significance, also due to the high number of variables to instrument (see Table B.2). The joint test of significance fails for each of the channel, suggesting that neither of them plays a relevant role in determining the different voting behavior between the national and regional level of elections.

2.8 Conclusions

Immigration has shown to be an important determinant of the growing support for populist parties all over Europe, as many authors have already pointed out. We confirm this result arguing that immigration fosters the support for anti-immigrant parties through three channels: (1) "ideological" anti-immigrant feelings; (2) crowding-out effect; (3) labor-market competition. There is not only an ideological anti-immigrant component to the

[23] The F is 2.72 with a corresponding p-value of 0.0528 for the specification of column (2).
[24] The F is 2.19 and the corresponding p-value is 0.0988 for the specification of column (4).

votes for the NL, but there are other important economic factors that play a role. These economic variables can help explaining a relevant share of variability in the difference share of votes collected by the NL across different levels of government, suggesting that voters take them into account when choosing who to vote for at different elections. After controlling for the ideological channel, our results suggest that the competition on the labor market dominates the crowding out effect.

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Table B.1 - Effect of immigration on the variation of the share of votes for the Northern League at the House's elections between 2008 and 2013 - Share variation specification

VARIABLES	Dependent variable: Delta NL share of votes 2013-2008, House elections			
	(1)	(2)	(3)	(4)
Share of immigrants	0.232***	1.291**	0.788	0.851
	(0.0506)	(0.582)	(0.644)	(0.542)
Immigration growth rate over 5 years	-0.00260	-0.00215	-0.00213	-0.00201
	(0.00316)	(0.00322)	(0.00319)	(0.00175)
Ln Italians avg income	-0.0291**	-0.0310**	-0.0381**	0.0133
	(0.0134)	(0.0135)	(0.0167)	(0.0180)
Ln Δ median income Ita-Imm	0.00789*	0.0158**	0.0210***	0.0178***
	(0.00395)	(0.00645)	(0.00545)	(0.00624)
Ln(Δ med income Ita-Imm) × Imm share		-0.114*	-0.198***	-0.141*
		(0.0631)	(0.0607)	(0.0722)
Italians empl. rate by LLS			-0.109	
			(0.0907)	
Employment rate blls × Imm share			1.873**	
			(0.913)	
Municipal Italians empl. rate				-0.186***
				(0.0550)
Employment rate bm × Imm share				0.736
				(0.492)
Town with Pop>15k	0.0123*	0.0132**	0.0121*	0.00727**
	(0.00658)	(0.00649)	(0.00633)	(0.00324)
Constant	0.289**	0.233	0.335**	-0.234
	(0.143)	(0.160)	(0.161)	(0.171)
Socio-economical controls	YES	YES	YES	YES
Local labor system fixed effects	NO	NO	NO	YES
Observations	1,408	1,408	1,408	1,408
R-squared	0.127	0.131	0.140	0.063
Number of LLS				57

Notes: Clustered (at the LLS level) s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table B.2 - Effect of the COEC and LMC on the difference of the share of votes for the Northern League between the House and Regional elections in 2013 - IV estimates

VARIABLES	Dependent variable: Difference in NL share of votes House vs Regional elections, 2013			
	(1)	(2)	(3)	(4)
Share of immigrants	-13.03	-5.525	-4.655	-3.111
	(82.00)	(11.62)	(9.549)	(6.074)
Immigration growth rate over 5 years	-2.626	-1.032	-0.334	-0.0518
	(16.79)	(2.207)	(1.897)	(0.922)
Share of immigrants squared in 2012	0.0576	-1.210	1.253	0.819
	(6.664)	(2.547)	(1.457)	(1.233)
Ln Italians avg income	-0.0517	-0.0933	-0.0540	-0.0846
	(0.128)	(0.146)	(0.0429)	(0.0728)
Ln Δ median income Ita-Imm	-0.222	-0.107	-0.0392	-0.0231
	(1.211)	(0.172)	(0.129)	(0.0515)
Ln(⊿ med income Ita-Imm) × Imm share	0.972	0.691	0.500	0.419
	(3.467)	(0.851)	(0.792)	(0.539)
Ln(⊿ med income Ita-Imm) × Imm gr 5 years	0.376	0.153	0.00989	-0.0147
	(2.349)	(0.313)	(0.206)	(0.113)
Italians empl. rate by LLS	-0.604	0.113		
	(7.331)	(0.845)		
Employment rate blls × Imm share	7.577	-0.303		
	(86.50)	(11.61)		
Employment rate blls × Imm gr 5 years	-0.577	-0.319		
	(2.968)	(0.674)		
Municipal Italians empl. rate			-0.142	0.0212
			(0.796)	(0.535)
Employment rate bm × Imm share			-0.0437	-1.136
			(5.175)	(3.354)
Employment rate bm × Imm gr 5 years			0.520	0.384
			(1.200)	(0.898)
Town with Pop>15k	-0.0971	-0.0367	-0.0189	-0.0117
	(0.627)	(0.0829)	(0.0547)	(0.0216)
Constant	2.692	1.873		
	(15.12)	(3.535)		
Socio-economical controls	NO	YES	NO	YES
Local labor system fixed effects	NO	NO	YES	YES
Observations	1,424	1,424	1,422	1,422
Number of LLS fixed effects			55	55

Notes: Clustered (at the LLS level) standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Instrumented variables in italics: the share of immigrants and its square are instrumented with the Card-instrument with base-year 2003 and its square, respectively; the growth rate of immigrants is instrumented with the difference of the Card-instruments with base-year 2003 and 1991.

Piling up catastrophes: medium and long-term effect of earthquakes[1]

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3.1 Introduction

Natural disasters cause fatalities and destroy property and infrastructure in a way similar to wars. We focus our attention on a specific type of catastrophic event: highly destructive earthquakes in Italian history. Earthquakes are a pervasive phenomenon in Italy, especially in its southern regions. We wonder what are the long and medium-term effects of destructive and catastrophic earthquakes on economic and social development.

To answer this question we analyze the long-term effect of earthquakes on economic development in a cross-section framework at the municipal level using a particularly rich

[1] We are very grateful to Massimo Filippini, Patricia Funk, Mario Jametti, Giuliano Masiero, Giovanni Pica, Raphaël Parchet and all other researchers at IdEP (USI) for enduring and tireless support and advices. We also thank Saverio Simonelli for valuable comments.

dataset on historic earthquakes. Moreover, we investigate the medium-term effect of earthquakes on economic and social development over the last 150 years, in a panel framework at the regional level, thanks to a newly assembled dataset on historical socio-economic data.

Our research is also part of the vast literature assessing the existing development gap between the northern and southern Italian regions. The North and the South part of Italy differ considerably with respect to several socio-economic indicators, such as per capita gross domestic product (GDP), education, life expectancy and human development. The South of Italy also lags behind in terms of political and individual rights and it was already far behind the Centre-North even at the unification of the country[2].

Many explanations about the determinants of this North-South gap have been proposed over the years. Felice (2013) divides the explanations in two strands: the accusatorial thesis and the exculpatory one, for both of which there is a strong and a weak version.

The accusatorial thesis points to the innate – if not genetic – differences of the southern people, specifically to their low cooperation ability, which dates back to the Norman domination of the Middle Ages. The exculpatory thesis argues – in its strong version – that the South of Italy is less developed because the North exploited it after the unification of the country in 1860. Moreover, this theory is based on the concept of "iattura" – bad luck – due to geographical disadvantages both in terms of lack of natural resources and distance to the big European markets.

We are particularly interested in the latter explanation, since some scientists, such as the well-known geologist Mario Tozzi, argue that catastrophic earthquakes might even be among the main reasons of the South of Italy's lower development. As he pointed out «the seismic crisis that hit Calabria intermittently for nearly a century – between 1702 and 1783 – remains the most impressive sequence of earthquakes that has hit our country so far. [...] That seismic storm turned into a crisis that faded an entire people. A kind of paralysis that left the Calabrian people numb, even in their spirit: many let themselves die. The crisis of the South of Italy also begins there».[3]

Inexplicably the earthquakes and the volcanic activity are nearly absent from the discussion of the determinants of the North-South gap, even if the two areas of the country are very different with respect to these aspects. Few scholars have investigated this

[2] Cfr. Felice (2013) for very detailed statistical information on this.
[3] M. Tozzi, La Stampa, October 2016, 31.

topic focusing on different earthquakes. Barone and Mocetti (2013) and Belloc et al. (2016) focus on the economic and institutional effect of earthquakes in Italy, finding that the consequence of an earthquake depends very much on the quality of the pre-existing institutions. Their results are mixed as is the literature on links between natural disasters and economics, in which some authors find that the effects are positive and others find that they are negative.

In this chapter we differentiate the long and medium term effect of earthquakes and try to find a link between these natural disasters and some measures of social capital, which is a well known determinant of the long term evolution of institutions, that are a key factor to economic development. Our results suggest that in the long-run destructive earthquakes seem to have a positive effect on the per-capita municipal disposable income. In the medium run, instead, only destructive earthquakes show a positive effect, as catastrophic ones seem to have a negative effect on the regional human development index. As a corollary, we find that the INGV seismicity classification is not particularly useful to understand the effect of earthquakes on the economic development, since it does not account properly for the way in which earthquakes lay out their medium and long-term effect on the economic system.

The chapter is organized as follows: section 3.2 revises the literature on the economic effects of natural disasters; section 3.3 details the debate about the North-South gap and the historical context; section 3.4 describes the Italian geological context; in section 3.5 we present our data and the measures of seismicity that we constructed; section 3.6 details our empirical model; section 3.7 presents our main empirical results and section 3.8 concludes.

3.2 Literature review

A wide strand of the literature on natural disasters has studied their effect on economic growth. Most of this literature has been developed using cross-country data and, as described by Felbermayr and Gröschl (2014), it has provided inconclusive evidence so far. Some papers find no effects for geophysical, geological and mild disasters (Skidmore and Toya, 2002; Raddatz, 2007; Cavallo et al., 2013; Felbermayr and Gröschl, 2013). Others find a positive effect for some types of disasters (Albala-Bertrand, 1993; Skidmore and Toya, 2002; Leiter et al., 2009; Crespo Cuaresma et al., 2010; Loayza et al., 2012; Fomby et al.,

2013; Felbermayr and Gröschl, 2013). Finally, some of the studies show that natural disasters, and especially extremely large ones, have a negative effect on economic growth (Hochrainer, 2009; Noy, 2009; Strobl, 2011; Fisker, 2012; Cavallo et al., 2013; Felbermayr and Gröschl, 2014; Hsiang et al, 2014; Shabnam, 2014).

The authors finding a positive effect of natural disasters on economic outcomes argue that these events act as a Schumpeterian creative destruction: the destruction of the older capital stock fosters a renovation of the equipment, which – in turn – determines the absorption of new technologies (Crespo Cuaresma et al., 2010). This leads to an increase in the rate of growth of total factor productivity (TFP), which supports GDP growth. Moreover there is a substitution from physical capital investments to human capital ones, which end up increasing the speed of human capital accumulation (Skidmore and Toya, 2002). Usually the caveat to these findings is that only developed economies actually benefit from natural disasters, while the effect for developing countries is negligible.

The scholars finding a negative effect argue that only big disasters have a significant effect and that it is fiercer on poorer countries, mainly due to five determinant factors: (i) quality of institutions, (ii) level of government spending, (iii) literacy rate, (iv) per-capita income and (v) degree of trade openness (Noy, 2009). Financial conditions seem to matter as well: countries with more reserves and receiving aid and inflows of remittances can react better to these type of shocks (Hochrainer, 2009; Noy, 2009; Felbermayr and Gröschl, 2014). Hsiang et al. (2014) highlight that the negative effect might be small, but it is very persistent and within twenty years can result in a loss of 7.4% of per-capita income. Fisker (2012) focuses on the within-country effects, claiming that while the consequences of destructive earthquakes could be negligible at the country level, they are significant at the local level.

Felbermayr and Gröschl (2014) argue that this inconclusive evidence about the effect of natural disasters on economic growth is due to the use of data from damage records of insurance companies. Indeed, the use of this form of data may lead to biased estimates, as selection into the database could be correlated with GDP. Contrary to most of the literature, they build a database of natural disasters using geophysical and meteorological information. Their data show a negative effect of disasters on economic growth. They also show that poor countries are hit more severely by geophysical disasters, while rich countries suffer more for meteorological events.

Another strand of the literature studies which factor can alter the consequence of natural disasters on economic outcomes. Among the studied causes, we identify the quality of political institutions, political revolutions/reforms and insurance payments. Cavallo et al. (2013), using a dataset covering 196 countries for the period 1970-2008 and synthetic control methods, show that only extremely large disasters have negative effects on economic outputs, both in the short and long-run. However, they also show that the effect is due to radical political revolutions following the disasters. Once they control for these political changes, even extremely large disasters do not have an effect on economic growth. Furthermore, Felbermayr and Gröschl (2014) show that international openness and democracy reduce the negative effect of natural disasters.

Barone and Mocetti (2014) study the effect of two different earthquakes in two different regions of Italy. Using a synthetic control analysis, they show that short-term effects are negative in both regions. However, they demonstrate that, in the long-run, financial aid has diverging effects: in the region with higher pre-quake institutional quality, financial aid that follow the earthquake has a positive effect on GDP. The positive effect is due to an increase in technical efficiency via a disruptive creation mechanism. Conversely, in the region with lower pre-quake institutional quality, financial aid has a negative effect, as it stimulates corruption, distorts the markets and deteriorates social capital. Nguyen and Noy (2018), using data from the 2010-2011 New Zealand earthquake, find that insurance payments can contribute significantly to the economic recovery after an earthquake.

The literature has also studied the effect of natural disasters on political institutions. Belloc, Drago and Galbiati (2016), using historical data from Italy, show that earthquakes in the period 1000-1300 delayed the transition from autocratic regimes to self-government (i.e. the commune) only in cities where the political and religious leaders were the same person, but not in cities where the two powers were distinct.

More recently, the literature started to study the effect of natural disasters on fiscal policies. Deryugina (2017), using data from the U.S., shows that hurricanes lead to a substantial increase in non-disaster government transfers. The present value of this increase exceeds that of direct disaster aid. This result suggests that the fiscal costs of natural disasters have been underestimated and that victims in developed countries are better insured than previously thought. Belasen and Polachek (2008) find that, while the income of the average worker might increase after being hit by a strong hurricane, there is also a negative effect on employment, which leads to an increase in public spending. Noy and

Nualsri (2010) study the fiscal consequences of natural disasters using panel data for a wide set of countries and highlight how developed countries react in counter-cyclical manner to these shocks, while developing countries pro-cyclically decrease their public spending. This worsens the negative effects of natural disasters and suggests why their effect is so different between rich and poor countries.

A recent branch of the literature studies how natural disasters affect individual economic behaviors and outcomes. Caruso and Miller (2015), using data from the Peruvian census, study the effect of the 1970 Ancash earthquake on individual human capital accumulation, 37 years after the shock. They show that individuals affected by the earthquake while in utero are less educated, fare far worse in the marriage market and become parents at younger age. They also show that natural disasters have negative effects in the long-run and provide evidence of intergenerational transmission of shocks. Gignoux and Menéndez (2016) analyze the long-term effects of earthquakes on individual economic outcomes. Using survey data from rural Indonesia, they find that, following an earthquake, individuals experience short term losses but recover in the medium run (i.e. 2-5 years), and show income and welfare gains in the long run (i.e. 6-12 years). The positive long run effect is due to external aid, which enables to reconstruct the stocks of productive assets (mainly farms), to improve public infrastructures and to recover productivity.

Boustan et al. (2017), using a 90 year panel dataset from the U.S., study the effect of natural disasters on migration rates, house prices and local poverty rates. They find that severe disasters increase migration rates and lower house prices, while milder disasters have little effect. Kirchberger (2017), using survey data from Indonesia, studies the effect of earthquakes on individual labor market outcomes. More specifically, the paper shows that earthquakes can have a positive effect on wage growth in the agricultural sector. This positive result is due to workers moving from the agricultural sector to the construction sector, raising the marginal product and the wages of labor in agriculture. Cai and Song (2017), utilizing survey data from China, examine the effect of natural disasters on weather insurance adoption. More specifically, running experimental insurance games with farmers, they demonstrate that experiencing natural disasters have a positive effect on real insurance take-up. Besides that, they show that informing farmers about natural disasters probability has a positive effect on insurance take-up. Between the two treatments, they find that knowledge of disasters probability has a greater impact.

The literature has focused on the short and long-run effect of natural disasters in a very detailed way, even if with inconclusive results. However, little has been said about the channels through which natural disasters might affect – either positively or negatively – economic growth (Cavallo and Noy, 2009). An important contribution of ours to the literature is the attempt to relate the earthquakes to the formation of social capital, as a reaction to adverse events.

3.3 Debate about the South development and historical context[4]

The wide debate on the causes and origin of the North-South gap can be synthetized following the scheme proposed by Felice (2013).

Starting with the accusatorial thesis, Putnam et al. (1994) – in their book on the evolution of institutions – attribute the cause of the low development of the South of Italy to a lack of social capital, giving foundations to the concept of "amoral familism" introduced by Banfield (1967). The stronger version of the accusatorial thesis is grounded on the excessive genetic variety, which can easily result into conflicts, while the weak one is based on the low level of social capital, which dates back to the late Middle Ages. Both versions find the southern people guilty for their status and leave, basically, no hope for solution, at least in the medium term.

The exculpatory thesis argues – in its strong version – that the South of Italy is less developed because the North exploited it after the unification of the country in 1860. This idea finds its maximum expression in Aprile (2010) which charges the Piedmonteses of genocides similar to the Nazi ones and describes the Bourbon regime as an enlightened one. Daniele and Malanima (2011) support this theory with their estimates on the per capita GDP at the unification of Italy, even if more recent and accurate estimates contradict their findings. The weak version of the exculpatory theory is based on the concept of "iattura" – bad luck – due to geographical disadvantages. Earthquakes and natural disasters in general would clearly be part of this explanation. The exculpatory thesis

[4] This section is based on Felice (2011)

tends then to declare innocent the southern society, either attributing the guilt to the North or highlighting the adverse environment.

Fortunato (1973) was the first to mention this idea, arguing that the southern mountains are harsh and steep, the rains are unpredictable, there is a lack of plains and coasts to build ports and, finally, the flow of the rivers is irregular. All these elements, together with malaria, landslides, floods and earthquakes doomed the South of Italy to its "geographic fate", on top of which there was the inadequacy and corruption of the local ruling classes. However, Fortunato's conclusion was that the misery of the southern people was inevitable, due to the poverty of the nature.

Another explanation of the North-South differences can be found in that the level of wealth inequality at the unification was much higher in the southern regions relative to the Centre-North. At that time the economy was mainly agricultural, hence the land property structure was the main determinant of inequality. In the North of Italy, the agricultural system was already evolving towards an entrepreneurial management of the lands, through intensive usage of the field, day workers, irrigation investments, chemic fertilization and with the integration between agriculture and manufacture. In the Centre of Italy the sharecropping was the most widespread agricultural practice and the entire family of the sharecropper was involved in running the farm.[5]

On the contrary, the agricultural activities in the Kingdom of the Two Sicilies were still mainly based on a feudal system. The barons and the baronial clergy had an enormous power and the latifundium was the norm. According to Villani (1973), in the continental southern regions – excluding the kingdom capital, Naples – more than 70% of the population depended from the barons, who were about 1‰. This agricultural structure also resulted in a different family structure: while in the Centre-North households were composed by many family units, in the South the households were mainly single family and that did not foster cooperation as it happened in the Centre-North. The peasants in the South kept being exploited by the barons even after the formal abolition of the serfdom in 1806 (1812 in Sicily) and were extremely poor, living in a subsistence condition.

Acemoglu (2005), in his work on the institutions, distinguishes the political and economic institutions in two types: inclusive and extractive. The former favor citizens' involvement, which fosters economic growth but also civil and human development. The latter have the sole scope of extracting rents from the citizens to divert them in the hand of

[5] Zamagni, 1990 and Romani, 1968.

few privileged individuals. The prevalence of the latifundium together with an extremely unequal wealth distribution in the Kingdom of the Two Sicilies ended up generating extractive institutions.

What is the relationship between the earthquakes and the southern institutions? A good example is provided by the case of "Cassa Sacra", a fund created by the Bourbon government right after the quake of 1783. The lands of 250 Calabrian convents were confiscated in order to distribute them to the poor people at a discounted price. However, due to the corruption of the Bourbon officials, the lands ended up being acquired by the wealthiest. The quake destroyed the previous social system and posed the bases for a new one. Earthquakes have then been a cause of the latifundium diffusion and of the development of extractive institutions even more based on the baronial system.

Italian unification has been an essential event in the XIX century. Contrarily to what happened in Germany, where Prussia – the most important German state – lead the unification, in Italy, it was the smaller Kingdom of Sardinia that fostered the unification of the peninsula. It is important to highlight the institutional context in which this unification is reached, because it allows us to underline what were the socio-economic and institutional differences at the time. Some authors, such as Daniele and Malanima (2011), suggest that the southern Italian region were actually as rich as the northern ones in 1860. However, more precise and recent historical statistics have shown that this was not the case, hence, it is crucial to understand where this differences originated from.

The Kingdom of the two Sicilies – ruled by the Bourbon dynasty – had twice the population of the Kingdom of Sardinia and more soldiers (130,000 against 100,000), but it was still an absolute monarchy, lagging behind both on social and economic grounds. Very little reforms were put in place after the 1848 rebellion and, in the following years, restauration was ferocious. The agriculture was still extensive-based and the latifundium was widespread. The economic system was still dominated by the noble classes: the serfdom was abolished in 1806 in the continental part of the kingdom and in 1812 in Sicily. Nonetheless the baronial system kept playing a very strong influence on the economy. In order to avoid to further upset the population, the fiscal pressure was kept extremely low and, as a result, there had been very little investments in infrastructure and social reforms.

The smaller Kingdom of Sardinia, instead, was a dynamic constitutional monarchy[6], led by the Earl of Cavour under the reign of Vittorio Emanuele II of Savoy. Deep reforms involved trade, finance, social and economic infrastructure, fostering agriculture and industrial development. The government put also in place a significant reform of justice and supported the separation between State and Church. The bourgeois and entrepreneur's class were directly involved in government management.

The two other major kingdoms in Italy were the Habsburg's Lombardo-Veneto and the Grand Duchy of Tuscany under the Habsburg-Lorraine. These two kingdoms were moderately progressive governments: road and rail infrastructure were built, and there were reforms in trade and agriculture – especially with the introduction of the land registries; education was promoted and some autonomy to local authorities was granted, in particular in the Lombardo-Veneto. Finally, there was the Pope State, which was a very conservative one, but at that time it was already reduced to a territory smaller than the current Latium region.

The differences between the Centre-North and the South of Italy are certified by the extension of the railroad and road networks, by the usage of the postal services, by the development of the banking and financial systems and by the literacy rate. Specifically, the meters of railroad per squared kilometer were 25 in Piedmont and Liguria, 10.6 in Lombardy and Veneto, 11.2 in Tuscany, 2.6 in the State of the Church and only 0.9 in the Kingdom of the Two Sicilies. The meters of road per squared kilometer were 645 in the North-West (Piedmont, Liguria and Lombardy), 538 in Tuscany and 130 in the South of Italy. As for the postal service, the received letters per capita were 6.1 in Piedmont and Liguria, 5.3 in Lombardy, 3.1 in Tuscany and 1.6 in the Kingdom of the Two Sicilies. This data – of course – is influenced by the much higher illiteracy rate of the southern regions: 86% in 1861, against a national average of 63%. In Lombardy and Piedmont the literacy rate was nearly 50%. Lastly, according to the most recent and reliable estimates, the GDP per capita in the South of Italy was about 20% lower than in the Centre-North in 1871.

The existence of this gap at the unification of the country is very important for our analyses, because it allows us to rule out the hypothesis that the Kingdom of the Two Sicilies was either richer, or as rich as the rest of Italy. Moreover, it suggest that the development gap was not due to the extractive institutions put in place by the Kingdom of Sardinia against the southern regions. In fact, the development gap of the South of Italy

[6] After the adoption of the Albertinian Statute in March 1848.

became a matter of political discussion right after the unification: the first studies on the topic were completed by Leopoldo Franchetti in 1873 and 1874[7]. Stated that the North-South gap does not depend on the unification process, we can move to the following section, where we analyze the geological differences between the North and the South of Italy.

3.4 Geological context

Italy is amongst the most-seismic countries in the world, together with Japan, Chile, Alaska, Indonesia, Russia, Ecuador, China, Tibet, Peru and Mexico[8]. Italian earthquakes, despite not reaching the highest magnitude levels, turn out to be very destructive, due to the combination of two factors: low depth of the epicenter and a soil composition that magnifies the oscillation generated by the quakes. Coupling that with a scare quality of buildings results often in huge damages to things and high number of casualties.

As an example, we mention the five most destructive Italian earthquakes of the last three centuries for number of casualties. The quake in Val D'agri (Basilicata), in 1857, had an estimated magnitude of 7.12 and caused 12,000 casualties. The earthquake of Monti Reatini and Aterno Valley, with a magnitude of 6.92, caused about 12-15,000 casualties in 1703. The Avezzano (Abruzzo) quake of 1915, with its magnitude of 7.08 resulted in 33,000 casualties. In 1783, the one in Pre-Aspromonte (Calabria and Sicily), with a magnitude of 7.03 caused 50,000 casualties. Finally, the 1908 quake in Messina and Reggio Calabria had a magnitude of 7.10 and caused 120,000 casualties: it was registered as the worst catastrophe for number of victims in Europe.

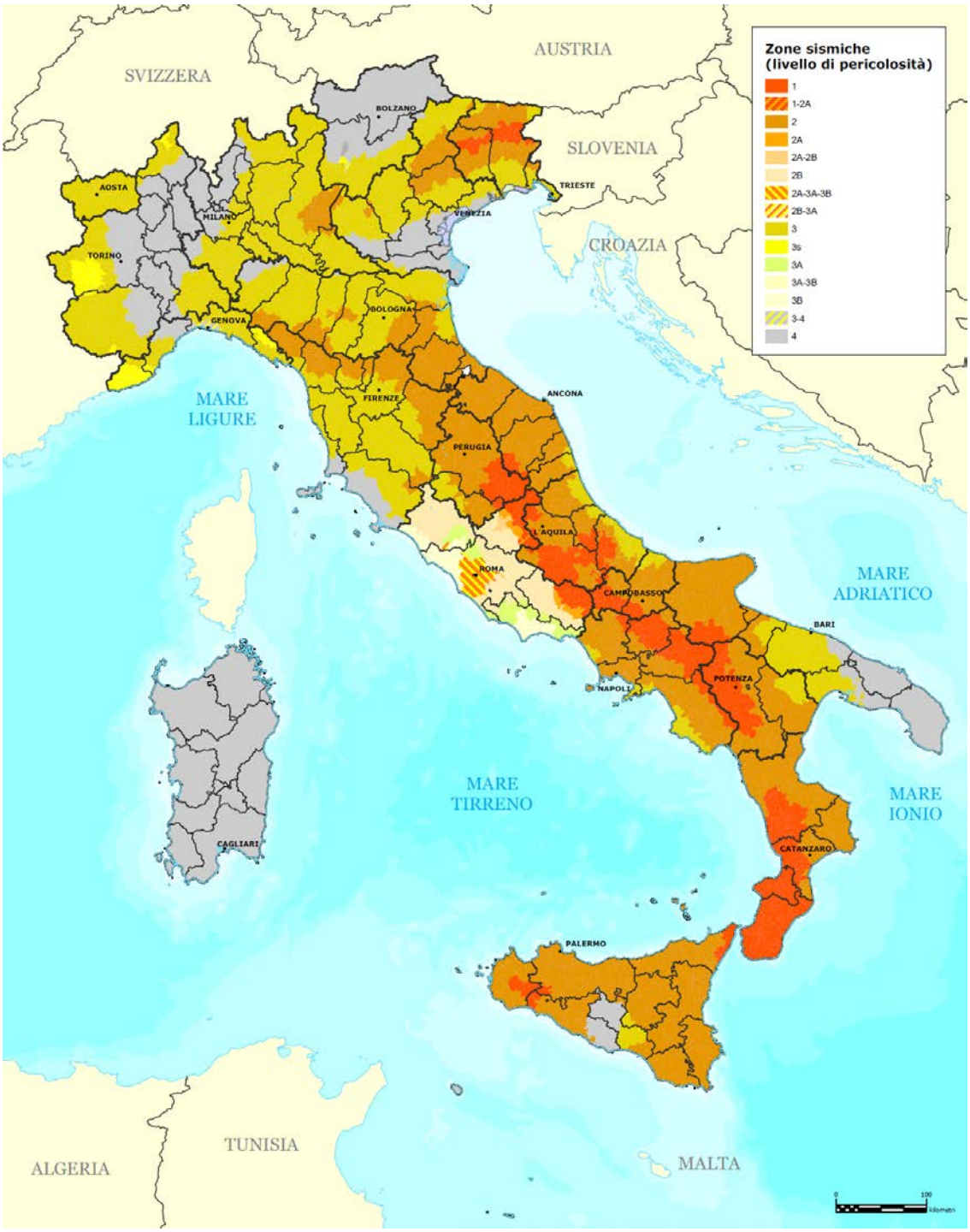
It is straightforward to note how all these catastrophic events were concentrated in the South of Italy. This part of the country is indeed very different from the rest of the country, geologically speaking. Figure 3.1 shows the seismicity map of Italy elaborated by the National Institute of Seismology and Volcanology (INGV). Clearly, the most-seismic areas are concentrated in the South of the country – with the exception of Apulia – and in

[7] Fenoaltea, *L'economia italiana*, cit., pp. 264-266

[8] The listed countries are the ones in which there have been the strongest earthquakes in the XX and XXI century, according to the United States Geological Survey. According to the same agency, the earthquakes causing the highest number of casualties happened in Haiti, China, Indonesia, Japan, Italy, Turkmenistan, Pakistan, India, Peru, Iran, Turkey, Armenia, Guatemala, Morocco, Tajikistan and Nepal.

the North-Eastern region of Friuly Venezia Giulia. As for Sicily, the most-seismic areas are the North-East and North-West ones.

Figure 3.1 – Italian seismicity map, 2014



Source: National Institute of Seismology and volcanology

INGV divides the Italian territory into four categories according to seismic risk: very high, high, low and very low. Overall, nearly 35% of the Italian municipalities have a high or very high seismic risk, but their distribution is extremely heterogeneous across the nation, in particular for the municipality with a very high seismic risk. 54% of the municipalities with a high seismic risk are in the southern regions, but nearly three out of four (73%) of the municipalities with a very high seismic risk are in the South, as it can easily be seen in Table 3.1.

Table 3.1 – Municipalities and seismic risk

Seismic risk	Center-North	%	South	%
Very high	190	27%	515	**73%**
High	916	46%	1060	**54%**
Low	2869	96%	128	4%
Very low	1865	92%	172	8%
Total municipalities	**5840**	**76%**	**1875**	**24%**

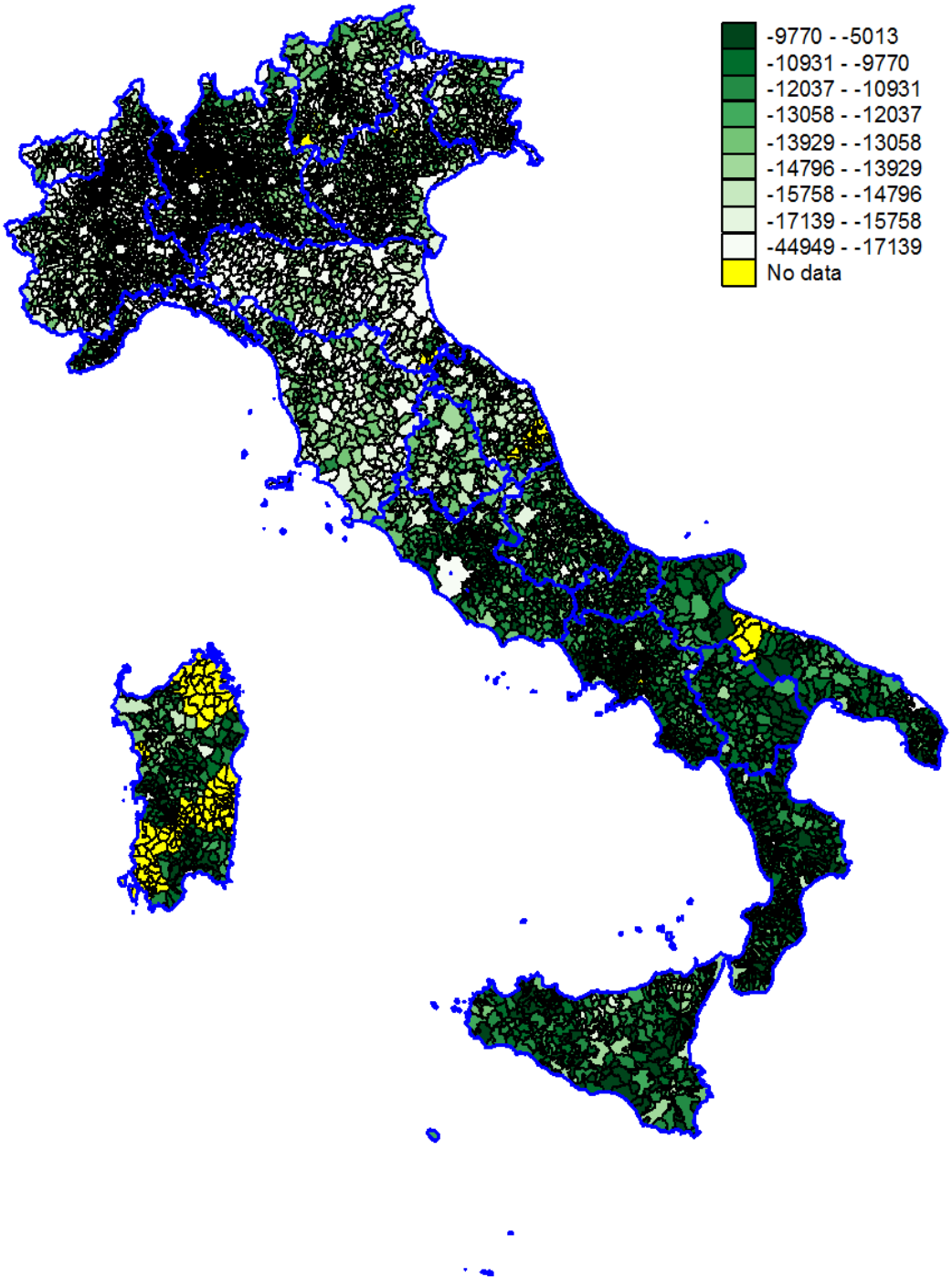
Our dataset comprises a total of 5958 registered earthquakes, from 217 b.C. to 2002 a.D., as reported in Table 3.2. If we divide them according to the Mercalli scale – that classifies the earthquakes with respect to their effects – we can see how 77% of the earthquakes involving casualties and a staggering 100% of the earthquakes causing catastrophic destruction happened in the South of Italy. However, it is not the case that there are no registered quakes in the Centre-North of the country: two thirds of the registered earthquakes actually happened in that part of Italy. Nonetheless, seismic events are not evenly distributed by intensity, with the strongest ones concentrated in the South of Italy.

Table 3.2 – Number of registered earthquakes

Category	Description	Center-north	%	South	%
1	non-perceived	2	100%	0	0%
2	perceived by few	148	89%	18	11%
3-5	perceived but no damages	2383	83%	480	17%
6-7	damages to things	1217	62%	732	38%
8-10	casualties	222	23%	742	**77%**
11	catastrophic destruction	0	0%	14	**100%**
12	apocalyptic destruction	0	0%	0	0%
	Total earthquakes	**3972**	**67%**	**1986**	**33%**

The concentration of the strongest seismic events in the southern regions led us to wonder whether there was a connection between important earthquakes and long-term economic growth. Figure 3.2 maps the average incomes by municipality in 2008.

Figure 3.2 - Average per-capita disposable income (2005, reverse scale)



They are shown according to a reverse scale, i.e. the municipalities with lower incomes being marked with a darker nuance of green. It is straightforward to note how similar Figure 3.1 and 3.2 look like, except for the highly seismic areas of the Friuly Venezia Giulia and the southern part of Umbria. This observation, on the one hand seems to suggest a correlation between strong quakes and economic development, and on the other hand seems to point to a mediating role of institutions, as suggested by Belloc et al. (2016).

3.5 Data and measures of seismicity

3.5.1 Data

We drew from three main sources to construct our dataset: (1) the National Institute of Statistics (ISTAT), (2) the National Institute of Seismology and Volcanology (INGV) and (3) several papers on historic economic data by E. Felice[9]. We constructed two datasets to analyze separately the long-term effect and the medium-term effect of earthquakes. Measuring the level of development is never an easy task, because there are many different indicators that can be used to describe it. Bearing this in mind, we tried to construct the widest possible set of indicators that are proxies for the socio-economic development.

The first dataset is a cross section at the municipal level, that we used for our long-term analyses. From ISTAT we gathered data on three dependent variables: the per-capita disposable income in 2005, the number of firms per capita and the number of non-profit associations per capita, a variable that is often used as a proxy for social capital. Moreover, we collected data on municipal population, active population and elderly index for the year 2005, that we will use as controls. From INGV we derived data on their updated index of seismicity (2015) and the historic records on Italian earthquakes from 217 b.c. and 2002 a.d., comprising the date of the event, the location of the epicenter, the intensity of the quake – measured both with the Mercalli and the Richter scale – and the number of

[9] From Felice and Vecchi, (2015), page 46, Table A.2, the GDP per capita from 1871 to 2009. From Felice (2009), page 7, Table 2, the VA per capita from 1881 to 2001. The hybrid HDI from 1871 to 2007 from Felice and Vasta (2015), page 52, Table 1. From Felice (2009), page 10, Table 5, the productivity per worker from 1871 to 2001. The total workforce from 1871 to 2001, from Felice (2009), page 14, Table 8. The agricultural employment from 1871 to 2001 from Felice, (2009), page 13, Table 7. Finally, from Felice, (2011), page 32, Table A.3, the pupulation growth from 1891 to 2001.

municipalities affected. Using these data we constructed a set of seismicity measures which will be discussed in detail in the next sub-section.

The second dataset is a panel at the regional level ranging from 1860 to 2011. We collected data from a set of economic history papers by E. Felice. These data comprise: GDP per capita, value added per capita, a hybrid human development index, per worker productivity, share of workforce, share of agricultural employment and population growth. These historic data come from academic articles published between 2009 and 2016 and are state of the art data, constructed with the most complete sources and precise technique. Despite referring to different time intervals, these data are usually on a decade basis and allow us to construct a small panel dataset that we use to investigate the medium-term impact of earthquakes on social and economic development after the Italian unification. From INGV we got the usual historic data on earthquakes, focusing our attention to the quakes which happened between 1860 and 2002.

3.5.2 Measures of seismicity

Starting from the data provided by the INGV, we consider five measures of seismicity: (1) the simple measure of seismic risk released by INGV, (2) the number of registered earthquakes, (3) the number of earthquake swarms, (4) a comprehensive measure of seismicity, defined "treatment" and, finally, (5) a "weighted treatment".

The INGV seismic risk ranges from 1 – very high risk – to 4 – low seismic risk. This measure summarizes the seismic risk of each municipality based on the number, intensity, and time passed by the past earthquakes. The distribution of the seismic risk among the Italian macro areas is shown in Table 3.1, while Figure 3.1 provides a visual representation of it across the Italian municipalities. There is no counterpart for this indicator in the panel framework, given that it is not updated at each seismic event.

Second, we count the number of past earthquakes, starting from a basic count of the number of quakes and then differentiating them depending on their intensity. Specifically, we define as "destructive" the quakes with a Richter intensity larger than 4.8 Mw – causing at least damages to things – and as "catastrophic" the quakes with a magnitude greater than 6.5, i.e. causing casualties and catastrophic destruction. Table 3.2 shows the distribution of historic earthquakes according to the type of damage that they caused, differentiating between the Center-north and the South of Italy. To construct its regional counterpart, we

weighted each earthquake by the share of municipalities that had been hit in each region at that seismic event.

The third measure that we consider introduces a more systematic accounting of the intensity of the quakes. We call it $treatment$, and – for the long-term specification of our analysis – it is defined by the following formula:

$$treatment_i = \sum_{t=-217}^{2002} earthquake_{it} \cdot intensity_{it} \qquad (1)$$

where $earthquake_{it}$ is the number of earthquakes occurred at time t in municipality i and $intensity_{it}$ is the associated Richter intensity scale. Clearly, in the medium-term specification of our analysis, this variable will account only for the earthquakes occurred in time-span at hand. As for the previous indicator, each quake has been weighted according to the share of involved municipalities.

The fourth measure that we consider is a weighted treatment, computed according to the following formula:

$$\frac{treatment_i}{timespan_i} = \sum_{t=-217}^{2002} \frac{earthquake_{it} \cdot intensity_{it}}{timespan_{i,(t+1)-t}} \qquad (2)$$

where $timespan_{i,(t+1)-t}$ stands for the time passing between the seismic event at time t in municipality i and the next one happening at $t+1$. The idea underlying this weighted formula is that if a quake happens before a municipality has fully recovered from the damages of the previous seismic event, the effect of the earthquake is going to be more severe. This measure – despite being quite rough – allows us to introduce a time dimension to the seismic events, giving more weight to the quakes happening close to one-another. There is no direct counterpart to this measure in a panel framework, which is why we decided to use it only in the cross-section analyses.

Finally, to account directly for earthquake swarms, we construct the variable $earthquake\_swarms_{it}$, which counts the number of non-singular earthquakes, i.e. the ones happening less than 10 years after the previous one in the same local area. Unless there have been huge episodes of corruption, within ten years from the first quake a community should have had the time to fix the damaged buildings. Given the definition of this variable it would have been difficult to find a sound counterpart at the regional level, hence we do not consider it in the panel analyses.

For the cross-section dataset, these five variables are computed over the entire time span of our dataset. On the other hand, – for the panel dataset – these variables account only for the quakes happened in the period before the realization of the dependent variable. Summary statistics for the cross-section and panel datasets are shown in Tables 3.3 and 3.4 respectively.

Table 3.3 - Descriptive statistics - Cross-section

Variables	Obs.	Mean	Standard deviation	Min.	Max.
Dependent					
Income per capita	7958	13544	3049	5013	44949
Firms per capita	8062	0.08	0.03	0.02	0.42
Non-profit associations per capita	7922	0.01	0.00	0.00	0.07
Explanatory					
INGV seismicity index	8062	2.86	0.93	1.00	4.00
Total number of earthquakes	8062	5.90	8.58	0.00	142.00
Time-span bw one eqk and the next	8062	69.57	117.09	0.00	1980.00
# of destructive earthquakes (Richter)	8062	4.37	7.09	0.00	132.00
# of catastrophic earthquakes (Richter)	8062	0.81	1.56	0.00	20.00
# of earthquake swarms (Richter)	8062	3.50	6.80	0.00	120.00
# of destructive eqk swarms (Richter)	8062	1.89	5.50	0.00	112.00
# of catastrophic eqk swarms (Richter)	8062	0.20	0.63	0.00	6.00
Destructive treatment (Richter)	8062	17.60	37.57	0.00	706.43
Catastrophic treatment (Richter)	8062	3.89	9.47	0.00	87.97
Weighted treatment (Richter)	8062	11.03	28.67	0.00	680.72
Weighted destructive treatment (Richter)	8062	6.06	23.10	0.00	652.51
Weighted catastrophic treatment (Richter)	8062	0.91	4.06	0.00	52.21
Controls					
Resident population	8062	7034	42186	31	2733908
Share of active population	8062	0.41	0.06	0.16	0.61
Elderly index	8062	1.89	1.53	0.00	35.00
Per-capita GDP in 1871 (regional)	8062	2074	351	1371	2997

Table 3.4 - Descriptive statistics - Panel

Variables	Observations	Mean	Standard deviation	Min.	Max.
Dependent					
GDP per capita	240	10916	9732	1371	35220
Value added per capita	190	6974	6997	905	25906
Hybrid HDI	228	0.64	0.21	0.20	0.92
Productivity per worker	171	0.97	0.23	0.42	1.67
Workforce (%)	171	47.09	8.98	26.13	82.33
Agricultural employment (%)	171	47.32	20.74	1.88	77.93
Population growth (%)	190	0.54	0.28	0.06	1.49
Explanatory					
# of destr. eqks (R) by r & p	280	0.36	0.48	0	2.66
# of cat. eqks (R) by r & p	280	0.04	0.17	0	1.68
Overall treatment (R) by r & p	280	2.52	3.28	0	16.63
Destr. treatment (R) by r & p	280	1.63	2.55	0	15.18
Cat. treatment (R) by r & p	280	0.04	0.72	0	12.03
Summary statistics					
# of eqk by region	280	85.81	48.31	0	166
# of eqk by r & p	280	6.65	6.85	0	49
# of municipalities by region	280	363.28	362.93	0	1541
Weighted # of eqk by r & p	280	0.46	0.58	0	2.89

3.6 Empirical model

Our empirical strategy is twofold: first, we analyze the long-term effect of cumulated earthquakes in a cross section setting at the municipal level; then, we investigate the medium-term effect of earthquakes on several development indicators in a panel, at the regional level, over 14 periods for the time-span 1860-2011.

3.6.1 Long-term cross section analysis

Our baseline specification is as follow:

$$y_i = \alpha + \delta_p + \beta_1 \cdot x_i + \gamma Z_i + \varepsilon_i \qquad (3)$$

where y_i can be – depending on the specification – the natural logarithm of disposable income per capita (in thousand of euros), the number of firms per capita, or the number of non-profit associations per capita (as a proxy for social capital) in municipality i; x_i is the explanatory variable of interest, which can be either the INGV seismicity index, or the total number of quakes that occurred in municipality i between 217 a.C. and 2002; Z_i constitutes a set of demographic controls, including municipal population, the share of active population and the share of the elderly (the share of people older than 65 years); δ_p are provincial fixed effects.

The previous regression is a bit too simplistic, because it differentiates neither for the quake's intensity, nor for the time passing between one earthquake and the following one. Hence, we now move to a specification differentiating between the levels of destructiveness of the earthquakes:

$$y_i = \alpha + \delta_p + \beta_1 \cdot d_i + \beta_2 \cdot c_i + \gamma Z_i + \varepsilon_i \quad (4)$$

where d_i is the number of destructive earthquakes, i.e. the ones causing physical damages to things and c_i is the number of catastrophic ones, i.e. the earthquakes causing casualties.

Despite being an improvement with respect to the baseline specification, the previous regression does not account for the specific intensity of each quake, which is why we introduce the $treatment$ variable, which can be differentiated by intensity of the treatment. Hence, we get the following specification:

$$y_i = \alpha + \delta_p + \beta_1 \cdot td_i + \beta_2 \cdot tc_i + \gamma Z_i + \varepsilon_i \quad (5)$$

Where td_i and tc_i are the treatment of destructive and catastrophic earthquakes suffered by municipality i. This specification – while accounting for the specific intensity of each quake – does not consider the time span encompassing between one quake and the next one. To deal with this issue, we first introduce the concept of earthquake swarms, i.e. the quakes happening within a ten years' time-span:

$$y_i = \alpha + \delta_p + \beta_1 \cdot dsw_i + \beta_2 \cdot csw_i + \gamma Z_i + \varepsilon_i \quad (6)$$

where dsw_i and csw_i are destructive and catastrophic earthquake swarms that hit municipality i. Finally, we weight each treatment by the time-span passing before the following shake, getting to the following specification:

$$y_i = \alpha + \delta_p + \beta_1 \cdot wtd_i + \beta_2 \cdot wtc_i + \gamma Z_i + \varepsilon_i \quad (7)$$

where wtd_i and wtc_i are destructive and catastrophic treatments experienced by municipality i in its history (see eq. 2).

We acknowledge that these long-run specifications, despite having several measures of clearly exogenous treatments, are not sheltered from potential confounding factors acting systematically at the local level or affecting a particular area of the country in a specific period. That is why we move to a panel specification at the regional level for the period 1860-2011.

3.6.2 Medium-term panel analysis

In the panel analyses we focused on the number of – either destructive of catastrophic – earthquakes hitting a region in a specific period and on their intensity. The panel setting allows us to take into account the time-invariant and region-specific unobservables and the time-varying unobservables that affect a specific period across all regions. First, we study the effect of the number of earthquakes hitting a region r in a specific period t, according to the following specification:

$$y_{rt} = \alpha_r + p_t + \beta_1 \cdot d_{rt} + \beta_2 \cdot c_{rt} + \varepsilon_{rt} \quad (8)$$

where y_{rt} can be – from regression to regression – the natural logarithm of the GDP per capita (in thousand of euros); the value added per capita (in thousand of euros); the hybrid human development index. d_{rt} and c_{rt} are – respectively – the number of destructive and catastrophic earthquakes hitting region r in period t. Finally, α_r and p_t are regional and period fixed effects, respectively.

The previous specification can be further improved accounting for the specific intensity of each quake:

$$y_{rt} = \alpha_r + p_t + \beta_1 \cdot td_{rt} + \beta_2 \cdot tc_{rt} + \varepsilon_{rt} \quad (9)$$

where td_{rt} and tc_{rt} are the treatment hitting a region r in period t in a destructive or catastrophic way respectively. In this setting we ignore the seismic swarms because the rule that we used to define it overlaps with the time periods of the panel analyses for most of the time intervals.

3.7 Main econometric results

The empirical results displayed in this section follow directly from the previous empirical model section. First, we show the cross-section long-term analyses together with some robustness checks, then we move to the medium-term panel analyses. Qualitatively speaking, our main results are in line with what previously found by Albala-Bertrand (1993), Skidmore and Toya (2002), Leiter et al. (2009), Crespo Cuaresma et al. (2010), Loayza et al. (2012), Fomby et al. (2013), Felbermayr and Gröschl (2013). Suffering strong earthquakes has a positive effect both on the long and medium-run economic growth; moreover, the same outcome emerges with respect to the evolution of social capital and the human development index.

3.7.1 Long-term analysis

The main cross-section results for the two economic outcomes considered – disposable income and firms per-capita – and for our measure of social capital – the number of non-profit associations per capita – are shown in Table 3.5, Table 3.6 and Table 3.7 respectively. The results are very similar for the three dependent variables studied and the three tables have a parallel structure, hence we will contemporaneously analyze them referring to their column numbering and the corresponding regression equations.

First, it is interesting to note how the INGV seismicity index has no effect (column 1, corresponding to equation 3), either on the long-run economic growth or on social capital development. However, this result is not very surprising, given that the INGV seismicity index measures the risk of being hit by an earthquake and not its actual realization. Nonetheless, as soon as we consider the raw number of earthquakes that hit each municipality, we find a positive and strongly significant[10] result for each dependent variable (column 2, equation 3). When we disregard the non-destructive earthquakes and focus only on the destructive and catastrophic ones, we still find a positive effect. The destructive quakes are strongly significant for each dependent variable, while the catastrophic ones have a stronger effect on the disposable income per capita, but they are not or less significant in determining the number of firms per capita and the number of non-profit association per capita respectively (column 3, specification 4). However, when we measure

[10] At the 1% level.

earthquakes more precisely with the treatment variable, we find a strong and significantly positive effect for both type of earthquakes on each of the three dependent variables (column 4, estimating equation 5).

Table 3.5 - Long-term effect of earthquakes on average disposable income

VARIABLES	Dependent variable: Ln of (Income per capita/1000)					
	(1)	(2)	(3)	(4)	(5)	(6)
INGV seismicity index	0.00597					
	(0.00736)					
# of at least destr. eqks (R)		0.00665***				
		(0.000548)				
# of destr. eqks (R)			0.00586***			
			(0.000582)			
# of cat. eqks (R)			0.0152***			
			(0.00373)			
Destr. treatment (R)				0.00112***		
				(9.99e-05)		
Cat. treatment (R)				0.00322***		
				(0.000521)		
Destr. eqk swarms (R)					0.00625***	
					(0.000585)	
Cat. eqk swarms (R)					0.0307***	
					(0.00711)	
Weigh. destr. treatment (R)						0.00111***
						(0.000128)
Weigh. cat. treatment (R)						0.00212
						(0.00133)
Resident population	5.62e-07***	1.41e-08	6.98e-09	1.14e-07*	1.90e-07**	2.82e-07***
	(1.68e-07)	(4.30e-08)	(4.59e-08)	(5.83e-08)	(7.47e-08)	(1.03e-07)
Active pop./total pop.	0.265**	0.257**	0.249**	0.267**	0.270**	0.273**
	(0.115)	(0.112)	(0.112)	(0.112)	(0.114)	(0.115)
Elderly index	0.0255***	0.0260***	0.0261***	0.0259***	0.0259***	0.0257***
	(0.00478)	(0.00479)	(0.00482)	(0.00479)	(0.00482)	(0.00478)
Constant	2.557***	2.570***	2.575***	2.565***	2.574***	2.574***
	(0.0662)	(0.0528)	(0.0524)	(0.0529)	(0.0535)	(0.0540)
Provincial FE	YES	YES	YES	YES	YES	YES
Observations	7,958	7,958	7,958	7,958	7,958	7,958
R-squared	0.576	0.605	0.606	0.599	0.592	0.585

Clustered standard errors (at the provincial level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 3.6 - Long-term effect of earthquakes on the number of firms per capita

VARIABLES	Dependent variable: Number of firms per capita/1000					
	(1)	(2)	(3)	(4)	(5)	(6)
INGV seismicity index	0.00121					
	(0.00150)					
# of at least destr. eqks (R)		0.000567***				
		(5.55e-05)				
# of destr. eqks (R)			0.000574***			
			(7.05e-05)			
# of cat. eqks (R)			0.000497			
			(0.000300)			
Destr. treatment (R)				0.000104***		
				(1.11e-05)		
Cat. treatment (R)				0.000244***		
				(3.68e-05)		
Destr. eqk swarms (R)					0.000565***	
					(6.12e-05)	
Cat. eqk swarms (R)					0.00257***	
					(0.000437)	
Weigh. destr. treatment (R)						0.000100***
						(1.22e-05)
Weigh. cat. treatment (R)						0.000223***
						(8.00e-05)
Resident population	3.37e-08**	-1.30e-08**	-1.30e-08**	-7.26e-09	2.01e-10	8.25e-09
	(1.36e-08)	(5.75e-09)	(5.71e-09)	(5.49e-09)	(6.04e-09)	(7.88e-09)
Active pop./total pop.	0.135***	0.134***	0.134***	0.135***	0.135***	0.136***
	(0.0186)	(0.0185)	(0.0185)	(0.0184)	(0.0184)	(0.0184)
Elderly index	0.00123***	0.00126***	0.00126***	0.00126***	0.00126***	0.00124***
	(0.000365)	(0.000368)	(0.000368)	(0.000368)	(0.000370)	(0.000369)
Constant	0.0185**	0.0222***	0.0221**	0.0217**	0.0225***	0.0225***
	(0.00836)	(0.00842)	(0.00846)	(0.00840)	(0.00838)	(0.00837)
Provincial FE	YES	YES	YES	YES	YES	YES
Observations	8,062	8,062	8,062	8,062	8,062	8,062
R-squared	0.347	0.361	0.361	0.359	0.356	0.352

Clustered standard errors (at the provincial level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 3.7 - Long-term effect of earthquakes on non-profit associations per-capita

VARIABLES	Dependent variable: Non-profit association p/c					
	(1)	(2)	(3)	(4)	(5)	(6)
INGV seismicity index	-0.000284					
	(0.000180)					
# of at least destr. eqks (R)		2.25e-05***				
		(5.52e-06)				
# of destr. eqks (R)			1.70e-05***			
			(6.41e-06)			
# of cat. eqks (R)			8.08e-05**			
			(3.09e-05)			
Destr. treatment (R)				3.75e-06***		
				(1.00e-06)		
Cat. treatment (R)				1.48e-05***		
				(3.71e-06)		
Destr. eqk swarms (R)					2.11e-05***	
					(6.32e-06)	
Cat. eqk swarms (R)					0.000102**	
					(3.98e-05)	
Weighted destr. treatment (R)						4.51e-06***
						(1.34e-06)
Weighted cat. treatment (R)						1.03e-05*
						(5.93e-06)
Resident population	-1.23e-09*	-3.07e-09**	-3.12e-09**	-2.74e-09**	-2.47e-09**	-2.37e-09**
	(6.50e-10)	(1.42e-09)	(1.40e-09)	(1.28e-09)	(1.20e-09)	(1.13e-09)
Active pop./total pop.	-0.00215	-0.00229	-0.00234	-0.00226	-0.00225	-0.00223
	(0.00220)	(0.00218)	(0.00219)	(0.00218)	(0.00218)	(0.00218)
Elderly index	0.000572***	0.000577***	0.000577***	0.000577***	0.000576***	0.000576***
	(0.000110)	(0.000111)	(0.000111)	(0.000111)	(0.000111)	(0.000111)
Constant	0.00856***	0.00752***	0.00755***	0.00751***	0.00753***	0.00753***
	(0.00111)	(0.00106)	(0.00106)	(0.00106)	(0.00106)	(0.00106)
Provincial FE	YES	YES	YES	YES	YES	YES
Observations	7,922	7,922	7,922	7,922	7,922	7,922
R-squared	0.391	0.391	0.391	0.391	0.391	0.391

Clustered standard errors (at the provincial level) in parentheses: *** p<0.01, ** p<0.05, * p<0.1

If we consider the earthquake swarms, we find again a significantly positive for both type of earthquakes, with the catastrophic ones having a stronger impact (column 5, equation 6). Finally, if we weight the treatment by the time-span encompassing between one quake and the following, we always find a positive and significant effect of the destructive ones. Instead, the catastrophic ones – despite showing a strongly significant effect on the firms per capita – seem to have no effect neither on the long run disposable income per capita, nor on the number of non-profit association per capita (column 6, equation 7).

All specifications include – as municipal controls – the resident population, the share of active population and the elderly index. The resident population shows a positive effect – even if not always significant – on disposable income, which is consistent with higher incomes in bigger municipalities. The effect on the number of firms per capita is unclear, changing sign and significance depending on the specification. Instead, it has a negative effect on the number of non-profit association per capita, suggesting that there is a higher concentration in smaller municipalities. The share of active population, as expected, has a positive effect on both the disposable income and the number of firms per capita. Conversely, it has a negative effect on the number of non-profit associations. Finally, the elderly index has a positive effect on each dependent variable, suggesting that the elderly are richer and that, if retired, participate more in non-profit associations.

What effect do our analyses predict in practice? Being hit by an additional destructive quake is associated to 0.56% increase in disposable income. The effect on disposable income of an additional catastrophic one is nearly three times: 1.51%. A destructive earthquake is associated to a 0.74% increase in the number of firms per capita, while the impact of a catastrophic one is slightly less, 0.64%. The impact of an additional destructive temblor is an increase in the number of non-profit associations of about 0.3%, while a catastrophic quake has an impact, which is more than four times: an increase of 1.44%.

In conclusion, as soon as we measure more precisely the earthquakes hitting a municipality we find a positive long-term effect both on the economic outcomes and on the social capital development. We are aware of the potential confounding factors that could bias the results in this cross section setting, in particular with respect to the disposable income per capita. Specifically, earthquakes could be correlated with some unobservables that were already at work before the unification of the country in 1860.

3.7.2 Robustness checks

We address the potential endogeneity issue with a twofold strategy. First, we compute again our measures of seismicity considering only the earthquakes that took place after 1872 and controlled for the regional GDP per capita in 1871, as reported in Table 3.8. If there was any pre-existing difference that we did not account for in our previous specification, in this way we believe that we can control at least for the unobservables correlated with the stock of earthquakes that took place before 1871. The regional GDP per capita in 1871 – as expected – is strongly significant, but this does not affect the significance of the coefficients associated to our measures of seismicity. This is reassuring, especially considering that – if anything – in these specifications, the coefficients are slightly larger.

As a further robustness check, we run a falsification test at the regional level. Specifically, we used the regional GDP per capita in 1871 as our dependent variable and we computed our usual measures of seismicity at the regional level for the earthquakes taking place from 1872 onwards. Clearly, these earthquakes should not be correlated with the GDP per capita in 1871. Table 3.9 shows the results for these specifications: none of our seismicity measures is significant, as we would expect.

We can then conclude that earthquakes actually play a positive and significant role in determining the current level of disposable per capita income. In the next sub-section we move to the panel specifications in order to study the medium-term impact of destructive and catastrophic earthquakes.

Table 3.8 - Long-term effect of earthquakes on avg disposable income - Sample post 1872 - Robustness [A]

VARIABLES	Dependent variable: Ln of (Income per capita/1000)			
	(1)	(2)	(3)	(4)
# of destructive eqks (R)	0.00868***			
	(0.000681)			
# of catastrophic eqks (R)	0.0236***			
	(0.00656)			
Destructive treatment (R)		0.00172***		
		(0.000120)		
Catastrophic treatment (R)		0.00327***		
		(0.000729)		
Destructive eqk swarms (R)			0.00892***	
			(0.000648)	
Catastrophic eqk swarms (R)			0.0205***	
			(0.00665)	
Weighted destructive treatment (R)				0.00154***
				(0.000160)
Weighted catastrophic treatment (R)				0.00313*
				(0.00171)
Resident population	1.11e-07***	1.38e-07***	1.67e-07***	2.38e-07***
	(3.61e-08)	(4.40e-08)	(5.71e-08)	(8.32e-08)
Active population/total pop.	0.251**	0.266**	0.265**	0.267**
	(0.111)	(0.112)	(0.113)	(0.114)
Elderly index	0.0263***	0.0260***	0.0259***	0.0257***
	(0.00487)	(0.00479)	(0.00480)	(0.00477)
Ln of (GDP per-capita in 1871/1000)	3.482***	3.061***	2.956***	2.662***
	(0.135)	(0.102)	(0.0981)	(0.0928)
Dummy missing dep.var.	0.151***	0.113***	0.102***	0.0754***
	(0.0129)	(0.0109)	(0.0107)	(0.0103)
Constant	-0.0409	0.266***	0.359***	0.581***
	(0.0853)	(0.0426)	(0.0378)	(0.0313)
Provincial FE	YES	YES	YES	YES
Observations	7,958	7,958	7,958	7,958
R-squared	0.610	0.605	0.599	0.590

Clustered (at the provincial level) standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 3.9 - Long-term effect of earthquakes on avg disposable income - REGIONAL sample post 1872
Robustness [B] - Falsification test

VARIABLES	Dependent variable: Ln of (Income per capita/1000)			
	(1)	(2)	(3)	(4)
# of destructive eqks (R)	-0.0158			
	(0.0347)			
# of catastrophic eqks (R)	0.0721			
	(0.169)			
Destructive treatment (R)		-0.00267		
		(0.00559)		
Catastrophic treatment (R)		0.0136		
		(0.0571)		
Destructive eqk swarms (R)			-0.0248	
			(0.0373)	
Catastrophic eqk swarms (R)			0.0263	
			(0.601)	
Weighted destructive treatment (R)				-0.00712
				(0.0104)
Weighted catastrophic treatment (R)				-0.0361
				(0.223)
Dummy missing dep.var.	0.0146	0.0142	-0.00671	-0.0143
	(0.0679)	(0.0721)	(0.0802)	(0.0749)
Dummy North-East	-0.0893	-0.120	-0.156	-0.158
	(0.160)	(0.173)	(0.191)	(0.211)
Dummy North-West	0.0276	-0.000966	-0.0513	-0.0586
	(0.259)	(0.281)	(0.288)	(0.311)
Dummy South	-0.351	-0.347	-0.342	-0.329
	(0.270)	(0.298)	(0.273)	(0.283)
Dummy Islands	-0.297	-0.321	-0.347	-0.339
	(0.285)	(0.315)	(0.301)	(0.321)
Constant	0.858**	0.885**	0.932**	0.936**
	(0.297)	(0.318)	(0.309)	(0.329)
Observations	20	20	20	20
R-squared	0.476	0.474	0.481	0.479

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

3.7.3 Medium term analysis

The panel analyses aim at studying the medium term effect of earthquakes at the regional level, taking also into account the share of municipalities that were actually affected by earthquakes in the period considered. The most important results of these analyses are shown in Table 3.10. The three main dependent variables of interest are the natural logarithm of the GDP per capita (in thousand of euros) and of the value added per capita (also in thousand of euros) and the hybrid Human Development index. Odd-numbered columns refer to equation (4), while even-numbered ones are estimates of specification (5).

Table 3.10 - Medium-term effect of earthquakes

VARIABLES	Dependent variables:					
	Ln of (Income per-capita/1000)		Ln of (value added per-capita/1000)		Hybrid Human Development Index	
	(1)	(2)	(3)	(4)	(5)	(6)
# of destr. eqks (R) by r & p	-0.00349		-0.00153		0.0195***	
	(0.0124)		(0.0281)		(0.00422)	
# of cat. eqks (R) by r & p	0.0777***		0.0349		-0.0155**	
	(0.0296)		(0.0381)		(0.00758)	
Destr. treatment (R) by r & p		-0.000585		-0.00176		0.00306***
		(0.00238)		(0.00497)		(0.000838)
Cat. treatment (R) by r & p		0.0108***		0.00715***		-0.00249***
		(0.00341)		(0.00256)		(0.000589)
Dummy missing dep. var.	-0.122**	-0.127**	-0.137***	-0.144***	0.00922	0.00553
	(0.0607)	(0.0638)	(0.0437)	(0.0452)	(0.00936)	(0.00916)
Constant	0.705***	0.706***	2.946***	2.951***	0.272***	0.272***
	(0.0525)	(0.0525)	(0.0644)	(0.0607)	(0.0146)	(0.0146)
Regional FE	YES	YES	YES	YES	YES	YES
Period FE	YES	YES	YES	YES	YES	YES
Observations	240	240	190	190	209	209
Number of regional codes	20	20	19	19	19	19

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Destructive earthquakes do not seem to play a role in the medium-term, at least for the evolution of the GDP and value added per capita. They show a negative coefficient, which, however, is not significant (columns 1 to 4). Catastrophic earthquakes, instead, keep on having a positive and significant effect, at least when they are measured as treatments and not simply counting the number of corresponding quakes. Quantitatively speaking, the effect of an additional catastrophic earthquake hitting a region is a 0.42% increase in GDP per capita.

The results for the hybrid HDI deserve a particular attention: in both specifications (columns 5 and 6), they appear to be strongly significant, but with opposite sign of the coefficients. Destructive earthquakes have a positive impact in the medium term, while catastrophic ones have a significant negative effect in the medium term, suggesting that while destruction of things and buildings might gather people together and – in turn – support the HDI, the loss of human lives harms the HDI. Indeed an additional catastrophic quake is associated to a 3.6% decrease in the HDI.

Lastly, we ran the same regression with respect to other four dependent variables: the productivity per worker, the share of workforce, the share of agricultural employment and the population growth rate (see Table 3.11). We detect only a positive effect of catastrophic earthquakes on the evolution of the share of agricultural employment. Considering the historic evolution of this variable across the Italian regions, it means that in the regions more affected by catastrophic quakes the share of agricultural employment fell slower. As for the other dependent variables, we found no significant result.

Table 3.11 - Medium-term effect of earthquakes

VARIABLES	Dependent variables:							
	Productivity per worker		Share of workforce		Share of agricultural employment		Population growth rate	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# of destr. eqks (R) by r & p	-0.00706		-1.123		-1.334		0.0238	
	(0.0326)		(0.994)		(1.865)		(0.0183)	
# of cat. eqks (R) by r & p	0.0176		0.458		3.367*		0.00702	
	(0.0252)		(0.818)		(1.773)		(0.0271)	
Destr. treatment (R) by r & p		-0.000918		-0.0751		-0.348		0.00458
		(0.00568)		(0.233)		(0.344)		(0.00311)
Cat. treatment (R) by r & p		-0.000167		0.116		0.504***		0.00297
		(0.00159)		(0.0857)		(0.134)		(0.00259)
Dummy missing dep. var.	-0.0157	-0.0161	-4.337***	-4.272***	5.667*	5.737*	0.0165	0.0156
	(0.0434)	(0.0438)	(1.262)	(1.335)	(3.099)	(3.155)	(0.0384)	(0.0387)
Constant	0.985***	0.985***	56.92***	56.89***	58.70***	58.72***	0.0509***	0.0524***
	(0.0622)	(0.0620)	(1.364)	(1.363)	(2.051)	(2.043)	(0.0126)	(0.0101)
Regional FE	YES	YES	YES	YES	YES	YES	YES	YES
Period FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	171	171	171	171	171	171	190	190
Number of regional codes	19	19	19	19	19	19	19	19

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

3.8 Conclusions

The relationship between earthquakes and economic and social development in Italy has not been analyzed in a comprehensive manner so far – also due to the lack of historical data. Taking advantage of a newly assembled dataset, we investigate the long and medium term effect of destructive and catastrophic earthquakes on some economic and social indicators.

Our results suggest that in the long-run earthquakes – both catastrophic and destructive – seem to have a positive effect on the per-capita municipal disposable income, the number of firms and the number of non-profit associations per capita. As a corollary, we find that the INGV seismicity classification is not very informative about the effect of earthquakes on the economic development, not accounting properly for the way in which earthquakes lay out their medium and long-term effect on the economic and social system.

In the medium run, destructive earthquakes exhibit no effect on the regional GDP and value added per capita. Catastrophic ones, instead have a positive impact on the evolution of these two indicators. More surprising are the results for the hybrid HDI: both destructive and catastrophic quakes appear to be strongly significant, but with the former having a positive impact and the latter a negative one. This seem to suggest that while destruction of things and buildings might gather people together and – in turn – support the evolution of HDI, casualties harms the HDI.

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